



NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

**NUCLEAR ENERGY IN SOUTHEAST ASIA:
PULL RODS OR SCRAM**

by

Pasit Somboonpakron

June 2009

Thesis Advisor:
Second Reader:

Michael S. Malley
Alice L. Miller

Approved for public release; distribution is unlimited

THIS PAGE INTENTIONALLY LEFT BLANK

REPORT DOCUMENTATION PAGE			<i>Form Approved OMB No. 0704-0188</i>	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE June 2009	3. REPORT TYPE AND DATES COVERED Master's Thesis	
4. TITLE AND SUBTITLE Nuclear Energy in Southeast Asia: Pull Rods or Scram			5. FUNDING NUMBERS	
6. AUTHOR(S) Pasit Somboonpakron				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES) N/A			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited			12b. DISTRIBUTION CODE	
13. ABSTRACT (maximum 200 words) Southeast Asia is experiencing a nuclear energy renaissance. Why have some Southeast Asian countries chosen to pursue nuclear power, while others have not? Among those pursuing nuclear energy, why are some moving more quickly than others? The hypothesis of this thesis is that countries are more likely pursue nuclear power if its benefits outweigh benefits from the same level of effort in other sources of energy. Analyses of these countries with respect to nuclear energy using electricity demand, alternative energy sources, political will, means of production, technical capacity and international support resulted in three categories: countries that abstain from it (Brunei, Cambodia, East Timor, Laos and Singapore), countries that may pursue it (Burma, Malaysia and the Philippines) and countries that are pursuing it (Indonesia, Thailand and Vietnam). Countries that abstained do so either because greater benefit can be achieved with the same level of national effort in other areas or because nuclear energy was politically ill suited to their specific needs. Countries on the fence face political obstacles that have yet to be overcome. Countries pursuing it do so based on a need to expand electricity capacity to sustain economic development, with the rate of pursuit dominated by their political circumstance.				
14. SUBJECT TERMS Southeast Asia, nuclear power, nuclear energy, nuclear reactor, and electricity demand,			15. NUMBER OF PAGES 131	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UU	

THIS PAGE INTENTIONALLY LEFT BLANK

Approved for public release; distribution is unlimited

NUCLEAR POWER IN SOUTHEAST ASIA: PULL RODS OR SCRAM

Pasit Somboonpakron
Lieutenant Commander, United States Navy
B.S., United States Naval Academy, 1996

Submitted in partial fulfillment of the
requirements for the degree of

**MASTER OF ARTS IN SECURITY STUDIES
(FAR EAST, SOUTHEAST ASIA, AND THE PACIFIC)**

from the

**NAVAL POSTGRADUATE SCHOOL
June 2009**

Author: Pasit Somboonpakron

Approved by: Michael S. Malley, PhD
Thesis Advisor

Alice Lyman Miller, PhD
Second Reader

Harold A. Trinkunas, PhD
Chairman, Department of National Security Affairs

THIS PAGE INTENTIONALLY LEFT BLANK

ABSTRACT

Southeast Asia is experiencing a nuclear energy renaissance. Why have some Southeast Asian countries chosen to pursue nuclear power, while others have not? Among those pursuing nuclear energy, why are some moving more quickly than others? The hypothesis of this thesis is that countries are more likely pursue nuclear power if its benefits outweigh benefits from the same level of effort in other sources of energy. Analyses of these countries with respect to nuclear energy using electricity demand, alternative energy sources, political will, means of production, technical capacity and international support resulted in three categories: countries that abstain from it (Brunei, Cambodia, East Timor, Laos and Singapore), countries that may pursue it (Burma, Malaysia and the Philippines) and countries that are pursuing it (Indonesia, Thailand and Vietnam). Countries that abstained do so either because greater benefit can be achieved with the same level of national effort in other areas or because nuclear energy was politically ill suited to their specific needs. Countries on the fence face political obstacles that have yet to be overcome. Countries pursuing it do so based on a need to expand electricity capacity to sustain economic development, with the rate of pursuit dominated by their political circumstance.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

I.	NUCLEAR POWER PHENOMENON IN SOUTHEAST ASIA.....	1
A.	INTRODUCTION.....	1
B.	IMPORTANCE.....	1
C.	PROBLEMS AND HYPOTHESIS	3
D.	WHAT THE NUCLEAR ENERGY COMMUNITY IS AND IS NOT DISCUSSING	7
1.	Current Situation	7
2.	What the Literature Discusses	8
3.	What the Literature Neglects.....	11
4.	Literature Review Conclusion	12
E.	METHODS AND SOURCES FOR THIS THESIS	13
F.	STRUCTURE OF THIS THESIS	13
II.	COUNTRIES ABSTAINING FROM NUCLEAR ENERGY	15
A.	THE FACTORS IN THEIR DECISION TO ABSTAIN	15
B.	ELECTRICITY DEMAND.....	15
1.	Brunei.....	16
2.	Cambodia.....	17
3.	Timor-Leste	18
4.	Laos	19
5.	Singapore	20
C.	AVAILABILITY OF ALTERNATIVE ENERGY SUPPLIES.....	21
1.	Brunei.....	22
2.	Cambodia.....	22
3.	Timor-Leste	23
4.	Laos	24
5.	Singapore	24
D.	POLITICAL WILL	25
1.	Brunei.....	26
2.	Cambodia.....	27
3.	Timor-Leste	27
4.	Laos	27
5.	Singapore	28
E.	ADEQUATE MEANS OF PRODUCTION TO DEVELOP NUCLEAR POWER.....	29
1.	Brunei.....	30
2.	Singapore	31
F.	TECHNICAL CAPACITY	31
G.	INTERNATIONAL SUPPORT.....	33
H.	CONCLUSION OF EACH COUNTRY'S DECISION.....	34
1.	Brunei.....	34
2.	Cambodia.....	35

3.	Timor-Leste	36
4.	Laos	36
5.	Singapore	37
6.	Closing Summary.....	37
III.	COUNTRIES THAT MAY POTENTIALLY PURSUE NUCLEAR ENERGY IN THE NEAR FUTURE.....	41
A.	INTRODUCTION.....	41
B.	ELECTRICITY DEMAND.....	42
1.	Burma.....	42
2.	Malaysia	44
3.	The Philippines.....	44
C.	AVAILABILITY OF ALTERNATIVE ENERGY SUPPLIES.....	45
1.	Burma.....	46
2.	Malaysia	47
3.	Philippines	48
D.	POLITICAL WILL	49
1.	Burma.....	50
2.	Malaysia	52
3.	Philippines	54
E.	ADEQUATE MEANS OF PRODUCTION TO DEVELOP NUCLEAR POWER.....	55
1.	Burma.....	55
2.	Malaysia	56
3.	Philippines	57
F.	TECHNICAL CAPACITY	58
1.	Burma.....	59
2.	Malaysia	60
3.	Philippines	61
G.	INTERNATIONAL SUPPORT.....	62
1.	Burma.....	63
2.	Malaysia and The Philippines.....	65
H.	CONCLUSION: EACH COUNTRY'S DECISION	67
1.	Burma.....	67
2.	Malaysia	67
3.	Philippines	68
4.	Closing Summary: Countries of Contradictions.....	68
IV.	COUNTRIES THAT HAVE ELECTED TO PURSUE NUCLEAR ENERGY ..	71
A.	INTRODUCTION.....	71
B.	ELECTRICITY DEMAND.....	72
1.	Indonesia and Thailand: Two Growing Peas in a Pods	72
2.	Vietnam.....	74
C.	AVAILABILITY OF ALTERNATIVE ENERGY SUPPLIES.....	75
1.	Indonesia.....	75
2.	Thailand	77
3.	Vietnam.....	78

D.	POLITICAL WILL	79
1.	Indonesia.....	79
2.	Thailand	82
3.	Vietnam.....	83
E.	ADEQUATE MEANS OF PRODUCTION TO DEVELOP NUCLEAR POWER.....	84
F.	TECHNICAL CAPACITY	87
G.	INTERNATIONAL SUPPORT.....	89
H.	CONCLUSION: EACH COUNTRY’S ROAD TO NUCLEAR ENERGY	92
V.	CONCLUSION AND POLICY RECOMMENDATION FOR NUCLEAR ENERGY DEVELOPMENT IN SOUTHEAST ASIA.....	97
A.	THE PURPOSE BEHIND THIS THESIS.....	97
B.	ANSWERING THE THESIS QUESTION	97
1.	Countries That Have Abstained From Nuclear Energy.....	98
2.	Countries That May Potentially Pursue Nuclear Energy in the Near Future	99
3.	Countries That Are Pursuing Nuclear Energy	101
C.	KEY FINDINGS AND IMPLICATIONS FOR THE UNITED STATES	103
D.	RECOMMENDED U.S. POSITION ON NUCLEAR ENERGY DEVELOPMENT IN SOUTHEAST ASIA.....	105
1.	The Benefits of an Engagement Policy.....	105
2.	Shaping the Engagement Policy	106
	LIST OF REFERENCES.....	109
	INITIAL DISTRIBUTION LIST	117

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF TABLES

Table 1.	Factors in Countries That Have Abstained From Nuclear Power.....	39
Table 2.	Factors in Countries That May Pursue Nuclear Energy	70
Table 3.	Factors in Countries That Have Committed to Nuclear Energy	95

THIS PAGE INTENTIONALLY LEFT BLANK

I. NUCLEAR POWER PHENOMENON IN SOUTHEAST ASIA

A. INTRODUCTION

Growing concern about the economic and environmental costs of fossil fuels has encouraged countries throughout the world to reconsider nuclear energy. Among them are several Southeast Asian countries. In particular, Indonesia, Thailand and Vietnam plan to begin using nuclear energy to generate electricity by 2020. However, despite similar concerns, other Southeast Asian countries are not considering nuclear energy as an alternative to fossil fuels or are on the fence about it.

This thesis aims to answer two main questions: Why have some Southeast Asian countries chosen to pursue nuclear power, while others have not? And among those that have opted for nuclear energy, why are some moving more quickly than others? In order to answer these questions, the underlying factors driving each country's position on nuclear energy must be analyzed. In the case of countries pursuing nuclear energy, analysis must address the same factors to reason out why they are moving at different speeds.

B. IMPORTANCE

The main reasons why nuclear energy development in Southeast Asia are significant are its contribution to sustaining economic growth, the safety concerns unique to this particular energy source, and the security concerns associated with nuclear material. Wide price fluctuations and the threat of inevitable exhaustion of fossil fuels increase the urgency of developing a large scale alternative in order to sustain economic growth. The rapid rate of development in Asia as a whole has produced a drastic rise in energy demand, which has also raised world energy costs. As the cost of conventional sources of energy rose over the last 10 years, nuclear energy gradually became a more

competitive alternative financially and environmentally.¹ In some Southeast Asian cases, the pressure to sustain growth and development is tied to regime legitimacy and even regime survival. How a Southeast Asian country deals with energy challenges and where nuclear energy fits into the picture can have implications for its future growth and development.

The mere pursuit of nuclear energy has safety and security ramifications for the entire region. The safety requirements associated with nuclear energy are unique because it uses fuel and generates waste materials that are extremely toxic with long decay lives. These must be handled with great care, especially in Southeast Asia where many adverse environmental conditions, such as monsoons, floods, earthquakes and volcanic eruptions, are common.² Disastrous events involving any aspect of nuclear power, whether man-made or natural, recognize no sovereign boundaries and will have negative impacts on the region at large for generations. The potential health and safety impact of such an event could be dramatic and widespread. Three Mile Island and Chernobyl stand as a grim reminder of that. Safety issues have already been vocalized by the Indonesian public.

Nuclear energy development in Southeast Asia poses significant concern in regional security. It is widely acknowledged that Southeast Asia is a transit point for transnational terrorists. The region also has problems with indigenous terrorist activities and armed separatist movements. Although these activities have been rare in Vietnam, they have been frequent in the two other countries most inclined to pursue nuclear power—Indonesia and Thailand. Countries developing nuclear energy must take account of these security risks which can threaten regional stability. Thus, security protocols must be sufficient to ensure the safety of such facilities against possible attacks. A second security concern is nuclear proliferation. With the pursuit of nuclear power comes the

¹ John Sheffield, "World Population and Energy Demand Growth: The Potential Role of Fusion Energy in an Efficient World," *Philosophical Transactions: Mathematical, Physical and Engineering Sciences* 357, no. 1752, *The Approach to Ignited Plasma* (1999): 378–379, <http://www.jstor.org/> (accessed July 30, 2008).

² Andrew Symon, "Southeast Asia's Nuclear Power Thrust: Putting ASEAN's Effectiveness to the Test," *Contemporary Southeast Asia* 30, no. 1 (2008): 5, <http://muse.jhu.edu.libproxy.nps.edu> (accessed July 31 2008).

risk of nuclear proliferation due to the possible development of latent nuclear capability as an offshoot.³ It is critical to identify the likely developers of nuclear power and fully analyze the intent and policies behind their nuclear energy programs.

C. PROBLEMS AND HYPOTHESIS

The major questions identified in the introduction lead to several important problems and issues associated with the development of nuclear energy in Southeast Asia. Only a small number of Southeast Asian countries are pursuing nuclear power even though all are facing similar energy pressures. The main hypothesis of this thesis is that countries are more likely to invest in nuclear power when its benefits outweigh those attained from the same level of national investment in other sources of energy. The factors in determining this opportunity costs are electricity demand, availability of alternatives, political will, means of production, technical capacity and international support. If the combination of these factors within a specific Southeast Asian country produces a favorable condition for nuclear energy, then that country pursues it. If not, they abstain from serious effort. Depending on the outcome of these six factors, some countries may also decide to postpone the decision to commit to nuclear energy until a later date, keeping the door open by expressing interest in the technology for future applications

A country's *electricity demand* is an important variable in accounting for whether or not it will pursue nuclear energy. It is the first aspect in assessing the need for nuclear energy. Future electricity demand in Southeast Asia is expected to be significantly larger than present demand. There are more consumers of energy in Southeast Asia today than in the past and there will be significantly more in the near future. The concentration of this increase is not evenly distributed across Southeast Asia. Individual countries will have different present and future electricity demands. The urgency of finding an alternative large scale energy source is tied to the gap between present and future electricity demands. Nuclear energy option becomes more appealing as this gap grows.

³ Dong-Joon Jo and Erik Gartzke, "Determinants of Nuclear Weapons Proliferation," *Journal of Conflict Solution* 51 (2007), 169–173, <http://muse.jhu.edu.libproxy.nps.edu/> (accessed November 17, 2008).

The *availability of alternatives* to nuclear energy for large-scale electricity production plays a significant role in determining whether a country will pursue nuclear energy. It is the second half of assessing a need for nuclear energy. Some Southeast Asian countries may have a relatively abundant amount of fossil fuel resources, making the need to pursue nuclear energy less urgent. Some countries may have other resources, such as hydro- or geothermal-power that can be used to produce large-scale electricity. Each country's energy portfolio will require an independent look and analysis in order to deduce how it affects the decision to pursue nuclear energy. The fewer alternatives a country has, the more likely it will commit to nuclear energy.

The endeavor to develop nuclear energy requires the support of the state. The level of *political will* for developing nuclear energy varies from country to country in Southeast Asia. Political will is a function of electricity demand, available alternatives and other domestic variables specific to that country in states where governments are more sensitive to the needs of its people. In Southeast Asian states where this is much less the case, the factors of electricity demand and available alternatives have a lesser effect. Political turmoil, lack of government effectiveness and transparency, a proclivity towards corruption and other inefficiencies are common problems in the governments of Southeast Asia. This issue greatly reduces a country's possibility to pursue nuclear energy by bringing into question its ability to maintain safety and security of such a program. For some Southeast Asian countries, mustering the political will to pursue nuclear energy is unachievable at present. Another part of the answer may also lie in analyzing the different political institutions in each country. An authoritarian political institution may have an easier time making the national decision to pursue nuclear energy and directing its national effort toward developing nuclear power. A more open or liberal state may spend a significant amount of time and effort debating the issue because of safety and security implications. The political nature and domestic drivers specific to each Southeast Asian country interested in nuclear energy will be a big factor in determining whether it will pursue nuclear energy and how committed it is to that pursuit.

Capital and labor can present an obstacle to nuclear energy development in certain Southeast Asian countries. Some Southeast Asian countries may not have the ability to

amass sufficient technical labor and capital to pursue nuclear energy. The issue of *adequate factors of production* to develop nuclear energy is also an application of opportunity cost analysis to indigenous factors of production. The more economic strength a country has, the better the chance that it can meet the heavy initial financial burden of a nuclear program. Likewise, the more skilled labor a country has in its workforce, the more likely it can build and maintain a nuclear power facility. The nature of a country's ruling regime may also impact the two subsets of this factor. An authoritarian regime may have less capital, but it may be more willing to spend a larger fraction of its GDP on a nuclear program. Skilled labor distribution in the same regime can likewise be directed more heavily towards a nuclear power plant if the regime desires it.

Another obstacle to developing nuclear power in Southeast Asia is acquiring the human capital and talent necessary to supervise the construction of a nuclear facility and to maintain and operate this program safely and effectively. The *technical capacity* aspect of nuclear power deals with the knowledge, proficiency and training of the operators and administrators. Acquiring and maintaining these skill sets in Southeast Asia requires significant investment on the part of the state and its public. Legions of scientists, engineers and administrative bureaucrats must be trained and a collective sense of integrity and commitment must be fostered, a feat that takes years, if not decades. Quality control, an issue in which Southeast Asian industries are notoriously weak, must be elevated to the high standards demanded by this field to withstand the torturous operating conditions of nuclear processes and the potentially inhospitable environment present in Southeast Asia. A country is more likely to pursue nuclear energy when it has higher levels of technical capacity.

Nuclear energy requires significant amounts of technical knowledge and resources. All Southeast Asian countries have accepted this reality and seek assistance from the international community. The support provided by the international community is the fundamental ingredient necessary to develop a nuclear energy program and includes technology, materials and political legitimacy (consent). Without these three elements, a Southeast Asian country's goal of nuclear power cannot come to fruition.

Sources of *international support* include the International Atomic Energy Agency (IAEA) and other nuclear technology holders such as the United States, China, Japan, Korea, France and Russia. The determinant of whether *international support* is provided hinges on national interest of the technology holder, including concerns of nuclear weapon proliferation and the impact on regional stability. As mentioned previously, nuclear energy development has regional implications for safety and security that recognize no borders. Any event involving nuclear material within the region can severely impact stability, a concern for many in the international community, especially for those that hold nuclear technology. Without some form of international support, nuclear energy will not succeed in any country in Southeast Asia.

Analyses of the eleven Southeast Asian countries for these six factors results in three categories. The first category is countries that are most likely to abstain from pursuing nuclear energy in the foreseeable future. These countries are Brunei, Cambodia, Timor-Leste, Laos and Singapore. The reasons for each countries decision are varied, but all are based on the specific realities each faces with respect to the six factors above. Brunei and Singapore are of special note because they are the only two in this category who have the national capability to pursue nuclear energy but choose to abstain. The second category is countries that may potentially pursue nuclear energy in the near future. These countries are Burma, Malaysia and the Philippines. Again, the reasons behind the decision of each country vary, with one or two factors playing a dominant role in each decision to abstain from pursuing nuclear energy for now. But what makes these countries special is that they each have internal drivers that may shift the balance of this decision away from abstinence and towards pursuing nuclear energy. The final category is countries that have elected to pursue nuclear energy. These countries are Indonesia, Thailand and Vietnam. Each pursues nuclear energy at different rates, with Vietnam being the most aggressive and Thailand being the least aggressive. On the surface this trend may seem contrary to their current electricity demand profile, but the other five factors weigh in to justify this trend.

D. WHAT THE NUCLEAR ENERGY COMMUNITY IS AND IS NOT DISCUSSING

The current trend in analyzing the development of nuclear energy in Southeast Asia is focused on its implications for weapons proliferation and safety. What is absent from recent studies is analysis of why each country in Southeast Asia has decided to pursue or not pursue nuclear energy. Also absent is an analysis of the reasons why the countries that have chosen to pursue nuclear energy are doing so at different speeds. This literature review is organized along the theme of what has been emphasized and what has been ignored in the literature on nuclear energy in Southeast Asia. It starts with some background information of where nuclear energy stands in Southeast Asia today and proceeds to assess how current issues on safety and nuclear proliferation are viewed within the region. It also addresses the absence of analysis on why each Southeast Asian country is or is not pursuing nuclear energy. Of significance in determining the “why nuclear power for some and not others in Southeast Asia” question is Peter Gourevitch’s hypothesis that different countries respond differently when facing the same economic crisis because of internal and external factors specific to these countries. Could the same be true about the decision to pursue or not pursue nuclear energy? This is the origin of this thesis. Internal and external variables represented by the six factors contribute to the decision on nuclear energy for each Southeast Asian country.

1. Current Situation

Currently Indonesia, Thailand and Vietnam are the countries in Southeast Asia serious about nuclear energy. All three have set goals of a functioning nuclear energy program by 2020. The International Atomic Energy Agency (IAEA) deems Vietnam and Indonesia as very advanced in their development of institutional capabilities necessary for a viable nuclear energy program.⁴ Malaysia, Burma, the Philippines and Singapore have expressed some level of interest in nuclear power. Malaysia lacks the level of urgency of the previous three. Burma is taking steps to get in the nuclear technology

⁴ Andrew Symon, *Nuclear Power in Southeast Asia: Implications for Australia and Non-Proliferation* (Sydney: Lowy Institute for International Policy, 2008), 11.

game with Russian assistance, but it is unclear whether this effort will eventually bear fruit in energy generation as planned.⁵ The Philippines is haunted by a previous bad experience with nuclear energy.⁶ Singapore lacks the necessary space for required safety stand-off range of nuclear site from urban areas (30 km).⁷ Cambodia also jumped on the nuclear energy bandwagon when it recently expressed goals to develop an operational nuclear energy program by 2020-2025.⁸ Even the oil-rich country of Brunei is keeping the nuclear-energy-door open by holding talks with nuclear energy experts from South Korea in early November 2008 on the applicability of nuclear energy for the oil-rich Sultanate.⁹

2. What the Literature Discusses

A critical concern among those discussing the renaissance of nuclear energy is nuclear proliferation. Both Iran and North Korea are in pursuit of nuclear technology. Each country initially claimed that its pursuit was for providing energy to its general population and was in keeping with the norms of peaceful utilization of nuclear technology. North Korea has since tested a nuclear device. Iran continues to alarm the international community with its less than transparent practices and defiance in

⁵ Bertil Lintner, "Burma's Nuclear Temptation," *Yale Center for the Study of Globalization* (2008), <http://yaleglobal.yale.edu/display.article?id=11673> (accessed March 13, 2009); Geoffrey Gunn, "Southeast Asia's Looming Nuclear Power Industry," *The Asia-Pacific Journal: Japan Focus* (2008), <http://www.japanfocus.org/Geoffrey-Gunn-Southeast-Asia-s-Looming-Nuclear-Power-Industry/> (accessed January 15, 2009).

⁶ Adrian Addison, "Philippines revisits nuclear energy option at 'white elephant' plant," *Agence France-Presse*, January 8, 2009, <http://www.globalcollab.org/Nautilus/australia/reframing/aust-ind-nuclear/ind-np/asean-nuclear-power/philippines> (accessed January 16, 2009); Raymund Jose Quilop, "Using Nuclear Energy: A Philippine Experience," Council for Security Cooperation in the Asia Pacific (CSCAP), Nuclear Transparency in the Asia Pacific, http://www.cscap.nuctrans.org/Nuc_Trans/links/frames/top-participants.htm (accessed January 16, 2009).

⁷ Lee Kuan Yew, Transcript of Minister Mentor Lee Kuan Yew's Dialogue with Singapore Energy Conference, November 4, 2008, Raffles City Convention Centre, <http://www.news.gov.sg/> (accessed November 19, 2008).

⁸ Ker Munthit, "Cambodia Eyes Nuclear Plant for Electricity," *Associated Press*, September 26, 2008, <http://www.ap.org> (accessed October 20, 2008); Kay Kimsong, "Cambodia Sets Sights on Nuclear Power," *The Phnom Penh Post*, Cambodia, September 29, 2008, <http://www.phnompenhpost.com> (accessed October 20, 2008).

⁹ Nurkhayrul Salam, "BEna to Host Forum on Nuclear Energy," *The Brunei Times*, Brunei, September 11, 2008, <http://www.bt.com.bn> (accessed October 20, 2008).

continuing a domestic uranium enrichment program. As a general trend, Iran has become even more secretive about its nuclear program. Much of the international community is very concerned with both countries.

Contrary to this trend, the international community is less concerned about nuclear weapons proliferation in Southeast Asian countries. The detailed study conducted by Michael Malley and Tanya Ogilvie-White suggests that only under significant threat of a neighboring country developing nuclear weapons will Indonesia or Vietnam weaponize. Since these two countries are the vanguard of nuclear development within the region and neither has yet moved to weaponization, it is unlikely that either one will because of the responsive nature of its views on weaponizing.¹⁰ In the case of Vietnam, further evidence of its non-proliferation intent was demonstrated when it recently returned weapons-grade uranium from the Da Lat research reactor to Russia for processing. This transfer was negotiated by the U.S. Global Threat Reduction Initiative.¹¹ As it stands, all ASEAN countries are parties to the Southeast Asian Nuclear-Weapon-Free Zone Treaty (SEANWFZ or Treaty of Bangkok, in effect since 1997).¹² No ASEAN country has demonstrated a trend deviating from this treaty. The threat of nuclear weapons in Southeast Asia is small unless something significantly changes in the political and/or security environment in Southeast Asia.¹³

With the ghosts of Three Mile Island (TMI) and Chernobyl still haunting nuclear energy, people in Southeast Asia are genuinely concerned about whether or not their government can ensure the safe operation of nuclear plants. As demonstrated by these two disasters, a nuclear incident has dire, wide-reaching and long-term effects. The safety culture developed by the nuclear power industry in Western countries has passed its heyday and is trying to redeem itself from TMI and Chernobyl. Constance Perin

¹⁰ Michael S. Malley and Tanya Ogilvie-White, "The Development of Latent Nuclear Capabilities in Southeast Asia: is the Outcome 'All Too Predictable'?" *The Nonproliferation Review* 16, no. 3 (March 2009), 27–28, <http://cns.miis.edu/npr/161toc.htm> (accessed March 15, 2009).

¹¹ Ralph Vartabedian, "A Race with the Terrorist," *Los Angeles Times*, Edition A-1, September 27, 2007, via Lexis-Nexis, <http://www.lexisnexis.com> (accessed August 2, 2008).

¹² Symon, *Nuclear Power in Southeast Asia: Implications for Australia and Non-Proliferation*, 13–14.

¹³ Malley and Ogilvie-White, 27–29.

nevertheless raises concern in an overview of how nuclear power safety culture grew and excelled during the formative years of nuclear energy, then declined. The safety culture became victim to complacency and neglect in the industry until disastrous events jerked it back into the limelight, if only for a little while.¹⁴

This simple human behavior pattern is not lost on the public in Southeast Asia. Couple this with a poor track record of public safety prevalent throughout the region and you have an environment where the public is greatly concerned about nuclear technical know-how and operational competence. This situation is especially true in the case of Indonesia.¹⁵ Already prone to numerous natural disasters by virtue of being part of “the Ring of Fire” along the Pacific Rim, the Indonesian government has compounded its precarious situation by deciding to locate its first nuclear power plant on a site near Mt. Muria (a dormant volcano). The threat of earthquakes presents an engineering safety issue in the construction of a nuclear plant. Add to that the possibility of a volcanic eruption and one can see why the Indonesian public (specifically environmentalists and local villagers) would express concern for safety.¹⁶

Other safety issues concern the acquisition of the technical know-how and operational competency. This investment in human capital is not out of reach for any serious nuclear energy developer. The IAEA and numerous other nuclear technology holders (including the United States, France, Russia, China, Japan and South Korea) are willing to provide training and assistance for the right price.¹⁷ This price may be in the form of non-tangibles like stability, influence, cooperation or policy support. In this sense, it pays to be the one guiding these fledgling nuclear energy developers to maturity.

Safety as the by-product of security is also a concern. Indonesia and Thailand are known transit points for transnational terrorists. Nuclear facilities in these countries

¹⁴ Constance Perin, *Shouldering Risks: The Culture of Control in the Nuclear Power Industry* (Princeton, Princeton University Press, 2005).

¹⁵ Malley and Ogilvie-White, 16.

¹⁶ Malley and Ogilvie-White, 8–9; Symon, “Nuclear Power in Southeast Asia,” 5.

¹⁷ Symon, “Southeast Asia’s Nuclear Power Thrust: Putting ASEAN’s Effectiveness to the Test?” *Contemporary Southeast Asia*, 30, no. 1 (2008), 126-130, Project Muse via Dudley Knox Library <http://muse.jhu.edu.libproxy.nps.edu> (accessed July 20, 2008); Symon, “Nuclear Power in Southeast Asia,” 5–7.

could serve as potential targets for these terrorists, whether for exploitation or direct action. Contemporary assessments are that Southeast Asian countries lack the security infrastructure and capability, at present, to prevent determined action against such facilities.¹⁸

With all this discussion and debate, a fundamental element is still missing from the analysis of nuclear energy in Southeast Asia. That is, if nuclear energy is becoming economically competitive and if there is no significant threat of weaponization in Southeast Asia, why are not all Southeast Asian countries pursuing nuclear energy as the alternative to fossil fuels?

3. What the Literature Neglects

Current discussions on nuclear power attribute its return as an alternative to fossil fuels for large-scale energy production to its increasing economic and environmental competitiveness. Of all eleven countries in Southeast Asia facing fossil fuel pressures, only three are seriously pursuing nuclear energy and only a handful more are making statements or gestures of interest in nuclear energy. If nuclear power is such a good solution for this issue, why isn't there more interest? Why aren't all Southeast Asian countries trying to pursue it, at least to a degree commensurate with their developmental situation? Maybe nuclear energy is not the best solution or, more specifically, maybe nuclear energy is not the best solution *for every Southeast Asian country*. Some insight into answering these questions may be found in Peter Gourevitch's study on policy choices of different countries responding to the same external pressure.

In *Politics in Hard Times*, Gourevitch studied five Western nations responding to three separate periods of economic crisis in the nineteenth and twentieth centuries. The purpose of Gourevitch's study was to understand the politics of policy choices of the countries in the case study.¹⁹ Gourevitch hypothesized that different factors both internal

¹⁸ Malley and Ogilvie-White, 16; Symon, "Southeast Asia's Nuclear Power Thrust," 130, 134 – 135; Symon, "Nuclear Power in Southeast Asia," 3, 11; Vartabedian, "A Race with the Terrorist."

¹⁹ Rand W. Smith, "International Economy and State Strategies: Recent Work in Comparative Political Economy," *Comparative Politics* 25, no. 3 (April 1993), 356–358.

and external can cause countries in similar situations to respond differently.²⁰ This principle of policy choices during economic crises can be translated to that of an energy crisis with little loss. After all, energy can be treated just like any other commodity that is traded internationally. An international economic crisis usually involves a significant change in the status of one or several factors in world trade, like a commodity. Energy pressures can worsen into crisis for Southeast Asian countries. To wait for such a crisis to emerge before trying to alleviate this pressure would be a poor energy policy. Each country will come up with its own specific response tailored to its specific conditions.

4. Literature Review Conclusion

The contemporary discussion on nuclear energy development in Southeast Asia is focused mainly on its security implications with little to no analysis on why each country has selected the policy choice to pursue or not pursue. Filling this gap will provide a better understanding of each Southeast Asian country's course of action. This can have policy implications in helping to anticipate the focal concerns of each emerging Southeast Asian nuclear energy program. An anticipatory foreign policy strategy has greater benefit than a reactive one. To develop an anticipatory calculus means identifying and concentrating on the same focal issues as the country of interest. In this case, the countries of interest are those that are pursuing nuclear energy. Currently, this list includes Indonesia, Thailand and Vietnam, but Brunei, Burma, Malaysia, the Philippines and Singapore cannot be entirely ruled out with a cursory glance. As outlined in Section C of this chapter, an alternative category of countries exists beyond those pursuing and those abstaining from nuclear energy. This third category of countries may decide to pursue nuclear energy in the near future when domestic and international conditions suit it. By understanding the factors behind the policy choices of these countries, it will be possible to anticipate whether their budding interest will bloom or wilt. Will other

²⁰ Peter A. Gourevitch, *Politics in Hard Times: Comparative Responses to International Economic Crisis* (New York: Cornell University Press, 1986), 19.

Southeast Asian countries follow suit if any of the three pursuers are successful? Only time will tell, but this thesis may give a shadow of what is to come by understanding the reasons behind current policies and positions.

E. METHODS AND SOURCES FOR THIS THESIS

This thesis conducts a comparative study among the Southeast Asian countries to ascertain why each country pursues or does not pursue nuclear energy using the six factors outlined in Section C. Pertaining to Indonesia, Thailand and Vietnam, further analysis is conducted to explain the different speed of pursuit.

Gourevitch's process would only cover a portion of opportunity cost analysis required in this issue. It touches on adequate production factors, political will and international support, but it leaves the material and resource aspects untouched. By including each country's energy demand, availability of alternatives, and technical capacity, this thesis tailors the analysis towards this more technical issue. In analyzing the combination of the six factors, this thesis addresses the problems and issues dealing with each state's ability and desire to develop nuclear power by fully assessing the opportunity costs of pursuing nuclear energy in Southeast Asia. The main sources for this analysis are energy, political and economic journal articles specializing in Asia and news sources.

F. STRUCTURE OF THIS THESIS

The analysis for this thesis covers three categories of Southeast Asian countries, each characterized by its members' attitude towards nuclear energy. This introduction chapter delineated the research question and its significance and established the initial hypothesis to be supported by subsequent chapters. Chapter II covers the analysis of Southeast Asian countries that have decided to abstain from pursuing nuclear energy in the foreseeable future. Each country's six opportunity cost factors will be examined and used to explain why nuclear power is not the right answer for solving its energy demand issues. Chapter III offers an analysis of Southeast Asian countries that may potentially pursue nuclear energy in the near future but have not taken a serious interest in it at

present. The six factors are used to assess why these countries have abstained from nuclear energy thus far and why they move to pursue nuclear energy in the near future. Chapter IV provides a detailed comparison among the countries that have decided to pursue nuclear energy according to the six factors and asks what accounts for the variations in each country's speed of nuclear energy development. Safety and security issues are also be analyzed in order to assess their impact in national decision making concerning the development of a nuclear energy program. Chapter V is a policy recommendation for how the United States should approach the expansion of nuclear energy in Southeast Asia.

II. COUNTRIES ABSTAINING FROM NUCLEAR ENERGY

A. THE FACTORS IN THEIR DECISION TO ABSTAIN

It is unlikely that Brunei, Cambodia, Timor-Leste, Laos and Singapore will pursue nuclear energy in the foreseeable future—*ceteris paribus*. The goal of this chapter is to determine how the six factors contributing to a country's decision on nuclear energy combine to affect their decision in light of the energy pressures they face. To recap, these six factors are electricity demand, availability of alternatives, political will, means of production, technical capacity, and international support. Some factors will have a more dominant effect on a particular country's decision making, depending on the specific circumstances of to that country. This chapter will define each factor and examine the effects it has on these five Southeast Asian countries, including comparisons and parallels between countries with stark differences or similarities. The chapter will conclude with an overarching assessment, drawing out the dominate factors for why each of these countries are not pursuing nuclear energy.

B. ELECTRICITY DEMAND

Electricity demand in Southeast Asia is driven by economic growth and development within the region. The Asia-Pacific Economic Cooperation (APEC) Energy Demand and Supply Outlook 2006 breaks down energy demand drivers in Southeast Asia as industry, transportation, residential and commercial. At present, industry and transportation are heavily dependent on oil in a manner that cannot be substituted by nuclear energy. Examples of these uses of oil are the petro-chemical industry and fueling commercial transportation such as trains, planes, automobiles and shipping. Regional industries do consume electricity but at a significantly lower rate than oil and other fossil fuels at present. As a country's industrial makeup increases in value-added industries, its dependency on electricity goes up, because value-added industries are generally more

depend on electricity. By 2030, it is expected that the largest share of industrial energy demand in Asia will be electricity based on the trend of industrial growth in Asia.²¹

The electricity demands analyzed by this thesis will focus on Southeast Asian industrial, residential and commercial sectors, which rely primarily on coal, oil, natural gas or hydropower. It can also be assumed that an urban populace consumes more electricity per capita than a rural populace, so an increase in urbanization will equate to a subsequent increase in energy consumption, mainly in electricity for residents and workplaces, natural gas for cooking and oil for transportation.²² Nuclear energy can contribute to the shares of electricity demand. Therefore if a country's demand for electricity is high, it is more likely that the country will seek nuclear energy to provide relief from fossil fuel dependency. Factors that will lead to high electricity demand are expansion of value-added industries and commercial sectors, and increased urbanization.

1. Brunei

Brunei is a small country whose electricity production capacity currently exceeds its consumption by a small margin.²³ Brunei's primary energy demand is anticipated to increase from 2.7 million tons of oil equivalent (Mtoe) in 2002 to 3.3 Mtoe in 2030. This increase in energy demand is driven by the growth in the electricity and transportation sectors. Brunei is a country rich in oil and natural gas, and its economy relies heavily on the export revenues from both. Facing the vulnerability of oil price volatility, Brunei is looking to break away from the resource curse by diversifying its sources of revenue. It is planning to expand and strengthen the hydrocarbon (petro-chemical) and non-oil (value-added) industries, seeking the potentially higher profit margins associated with

²¹ Asia-Pacific Economic Cooperation (APEC), *APEC Energy Demand and Supply Outlook 2006: Executive Summary*, Asia Pacific Energy Research Center (Tokyo, 2006), 2, <http://www.ieej.or.jp/aperc/outlook2006.html> (accessed December 23, 2008).

²² Ibid., 5.

²³ Central Intelligence Agency, "Geography, People, Government and Economy Information," *The World Factbook: Brunei*, (2009), <https://www.cia.gov/library/publications/the-world-factbook/> (accessed January 26, 2009).

these sectors. Expansions of its industries in this direction will increase its electricity demand overall. To account for this, Brunei is also planning to extend its electricity grid and increase its electricity generation capability.²⁴

A high urbanization rate is a consequence of Brunei's continuing development and fossil fuel riches. The Brunei Darussalam provides for numerous public goods to include state funded education and healthcare, and subsidies for rice and housing.²⁵ The combination of these social services and the growing urban job demand driven by economic expansion makes for a good incentive for people to flock to cities and urban centers. In 2002, Brunei was 75% urbanized. This number is expected to reach 85% by 2030.²⁶ Brunei is experiencing growth in value-added industries and urbanization. Both are drivers for increased electricity consumption and favor the development of a large scale energy system like nuclear energy when electricity demand is exclusively examined. However, Brunei's plan for expanding its electricity production capacity is all natural gas based and not nuclear.

2. Cambodia

Cambodia's electricity infrastructure was heavily damaged by war and is currently in a recovering state. The source of electricity for the majority of the country is diesel generators connected to ad-hoc electrical grids. Cambodia's capital Phnom Penh accounts for about 70% of the country's electricity consumption. This primary urban center is home to the majority of Cambodia's industry made up mostly of textile, garment and shoe manufacturing. This accounts for a large its share of electricity consumption. Cambodia's primary obstacle to meeting its electricity demand problem is its lack of infrastructure; generation capacity is a close second. Ironically, poor infrastructure gives

²⁴ Asia-Pacific Economic Cooperation (APEC), *APEC Energy Demand and Supply Outlook 2006: Brunei Darussalam*, Asia Pacific Energy Research Center (Tokyo, 2006), 7-10, <http://www.iece.or.jp/aperc/outlook2006.html> (accessed December 23, 2008); Department of Energy (DOE), "Country Analysis Brief: Brunei," *Energy Information Administration (EIA) of the United States Government*, November 20, 2000, <http://www.eia.doe.gov/emeu/cabs/brunei.html> (accessed December 22, 2008).

²⁵ CIA, *The World Factbook: Brunei*.

²⁶ APEC, *APEC Energy Demand and Supply Outlook 2006: Brunei Darussalam*, 7-10; DOE, "Country Analysis Brief: Brunei."

this sparsely electrified country one of the highest electricity prices within the region.²⁷ The Cambodian government is looking to expand electrification within the country in order to improve the standard of living of the populace and ensure sustainability for future growth. For on-grid sectors, Cambodia is looking to improve basic infrastructure in order to improve efficiency and minimize electrical losses. For off-grid sectors, Cambodia is looking to renewable energy sources such as solar and wind energy on a communal scale to take advantage of their potential long-term benefits.²⁸ Future electricity demands in Cambodia were expected to greatly increase based on the rate of development prior to the 2008 global recession. With current economic uncertainties, that rate of development will be negatively impacted.

Provincial towns are expected to consume a peak of up to 173 MW by 2010. Approximately 85% of the population is rural. Cambodia's population is mostly rural and widely dispersed, making it less conducive to a centralized large-scale power output system like nuclear plants. Based on its relatively small electricity demand and lack of infrastructure, it would make more sense to invest in essential infrastructure repairs and development rather than nuclear energy to meet Cambodia's present and future electricity demands.

3. Timor-Leste

The Democratic Republic of Timor-Leste is still recovering from its chaotic emergence into the international community as an independent nation. The recent crisis has left Timor-Leste's energy infrastructure devastated. The World Bank's International Development Association is working with Timor-Leste to restore the Comoro Power station and the electrical power distribution to Dili. This assistance will extend to rehabilitating Timor-Leste's Ministry of Natural Resources, Minerals and Energy Policy

²⁷ United Nations, "Draft: Cambodia Energy Sector Strategy," United Nations Department of Economic and Social Affairs, Division for Sustainable Development, 5–14, <http://www.un.org/esa/agenda21/natlinfo/countr/cambodia/energy.pdf> (accessed December 23, 2008).

²⁸ Ibid, 6 -7; Chandara Lim and Suon Ponnarath, "Energy Resources in Cambodia," General Directorate of Energy Hydro Electricity Department, Hangzhou Regional Center (Asai-Pacific) for Small Hydro Power (SHP), http://www.hrcshp.org/en/world/db/Energy_Resources_in_Cambodia.pdf (accessed December 23, 2008).

(MNRMEP) and the U.N. established national utility company, Electricidade de Timor-Leste (EdTL), to become self-sufficient and effective in the long term.²⁹

The power system left by Indonesia's National Power Corporation (NPC) in 1999 was severely damaged during the violence and destruction of that year. EdTL is currently operating this power system and providing electricity to about 43,500 households or 22% of the country. Approximately half of these households are in Dili and its surrounding areas. This urban area is about 85% electrified comparing to the 5% in the rural areas. In June 2007, residential consumption of energy (both urban and rural) accounted for 55% of Timor-Leste's electricity demand. Industrial and commercial consumption of electricity accounted for only 26% of the country's overall demand, and government use for the remaining 19%. The country's electricity demand is being met entirely by imported diesel making the price of electricity one of the most expensive within the region (like Cambodia).³⁰ At present, Timor-Leste's electricity demand issues surround the re-establishment of necessary infrastructure to free itself from the heavy dependency on external support for electrical power. Nuclear energy is more than a distant aspiration for this troubled nation.

4. Laos

The Lao People's Democratic Republic (Lao PDR) currently has a small electricity demand that is expected to moderately grow in the next decade. Its population is 80%³¹ rural and agriculture (mostly rice farming) still accounts for the largest share of its GDP (~40%). The urbanization rate is low since Laos had no railways and only a rudimentary road system, and so much of its GDP is still dependent on agriculture. Lao

²⁹ The World Bank, *Project Paper on a Proposed Grant in the Amount of SDR 1.64 Million (US \$2.5 Million Equivalent) to the Democratic Republic of Timor-Leste for Energy Services Delivery Project*, The World Bank International Development Association Report No: 39717-TP, June 7, 2007, 1, http://www-wds.worldbank.org/external/default/main?pagePK=64193027&piPK=64187937&theSitePK=523679&menuPK=64187510&searchMenuPK=64187283&siteName=WDS&entityID=000020439_20070614093828 (accessed December 23, 2008).

³⁰ Ibid., 2.

³¹ Sommano Pholsena and Daovong Phonekeo. *Loa hydropower potential and policy in the GMS context*. United Nations Symposium on Hydropower and Sustainable Development Beijing, China, October 27, 2004, 2.

industry is based on resource extraction with the largest sectors being mining and hydro-electric power export (30% of GDP revenue). Its main client for hydropower export is its electricity-hungry neighbor Thailand, with plans to start selling electricity to Vietnam in 2010.³²

At present, Lao's electricity generation capability is about 685 MW with the majority coming from hydropower (~98% or 671 MW) and the small remainder coming from diesel.³³ In 2007, only 59.3% of the electricity produced by the Lao PDR was consumed domestically.³⁴ Even with no additional generation capacity brought online, the domestic peak electricity demand would not grow to match current production capacity until 2020.³⁵ Lao's relatively small electricity demand compared to present generation capacity negates the need to look at nuclear energy as an alternative source of electricity.

5. Singapore

Singapore is a small city-state nation with a high per capita electricity demand. As a city-state, the majority of Singapore's populace is urban. Singapore fits the energy profile of a country that would be interested in nuclear energy when looking only at electricity demand. Singapore's electricity is supplied mostly by natural gas with a small fraction being generated by oil fire power plants. Electricity demand in Singapore is projected to increase significantly over the next 20 years (3.7% annually) and is expected to reach 18 GW by 2030.

³² Pholsena and Phonekeo, 5; Central Intelligence Agency, *The World Factbook: Laos*, "Geography, People, Government and Economy Information," (2009), <https://www.cia.gov/library/publications/the-world-factbook/> (accessed February 5, 2009).

³³ Pholsena and Phonekeo, 3.

³⁴ Sanhya Somvichith, *Hydropower in Lao PDR and Power Development Plan*, powerpoint presentation at Executive Summary on Electricite Du Laos (EDL) and Laos Hydropower Development, November 21, 2008, Department of Electricity, Ministry of Mines, <http://www.edl-laos.com/> (accessed December 30, 2008).

³⁵ Sithanh Vongsiry and Khamphanh Vanlasy, *2002 International Training Course on Chinese SHP*, Lao Peoples Democratic Republic Ministry of Industry and Handicraft Electricite Du Laos Country Paper (Vientiane 2002), Hangzhou Regional Center (Asai-Pacific) for Small Hydro Power (SHP) <http://www.hrcshp.org/en/world/db/Laos.pdf> (accessed December 23, 2008).

The main drivers of this growth are the residential and commercial sectors of Singapore. Residential electricity consumption is growing because of the large urban populace and high standard of living. Space cooling is the primary consumer of electricity in Singapore's residential sector, but increased appliance and electronics use also contribute. Commercial electricity use is high because Singapore is Southeast Asia's financial and high-tech hub. Commercial electricity use is expected to grow at 4.4% annually. Electricity is the only energy source utilized in Singapore's commercial sector.³⁶ From an electricity demand perspective, nuclear power may seem to be an ideal means of electricity generation. Singapore has a high electricity demand localized in a very small geographic area with a well established electrical grid but other factors will drive Singapore's calculus away from nuclear energy.

C. AVAILABILITY OF ALTERNATIVE ENERGY SUPPLIES

The availability of alternatives to nuclear energy for electricity production also plays a significant role in determining whether a country will pursue nuclear energy. Some Southeast Asian countries are rich in fossil fuel resources, making the need to pursue an alternative energy source like nuclear power less urgent or unnecessary for the foreseeable future. It is essential to examine a country's alternative energy sources and compare those to its electricity demand. These two factors are closely related and have a profound impact on each other. The fewer available alternatives to nuclear energy a country has, the more likely that country will commit to nuclear energy. This thesis does not consider energy resources such as biomass, palm oil, solar and wind energy to be viable large scale alternatives to nuclear energy because of their present limitations for use as a large scale energy sources. Typical candidates for consideration as available alternatives are oil, natural gas, coal, hydropower and geothermal energy in some cases.

³⁶ Asia-Pacific Economic Cooperation (APEC), *APEC Energy Demand and Supply Outlook 2006: Singapore*, Asia Pacific Energy Research Center (Tokyo, 2006), 85 – 89, <http://www.iecej.or.jp/aperc/outlook2006.html> (accessed December 23, 2008).

1. Brunei

As mentioned in the electricity demand section, Brunei has extensive oil and natural gas reserves. The export of both forms of energy resources account for over 50% of Brunei's GDP and over 90% of its total exports. Furthermore, Brunei has made a 99% shift to natural gas for electricity generation. Its large natural gas reserves have prompted the government to maintain this electricity generation policy out to at least 2030. The electricity generation capacity of Brunei will increase from 2,700 GWh in 2002 to 3,100 GWh by 2030, all powered by natural gas. These reserves are large enough to meet the projected growth in electricity consumption resulting from industrial expansion and urbanization discussed in the electricity demand section and negates the need for developing nuclear energy for Brunei's foreseeable future.³⁷

2. Cambodia

Cambodia's underdeveloped conditions result in a lot of speculations about its energy resources. Recently oil and natural gas reserves were discovered beneath Cambodian territorial waters.³⁸ Taking into account Cambodia's relatively low electricity demand, high need for revenue and lack of refining capability, these newly discovered resources will more than likely be extracted for export. Chinese mineral surveys from the late 1950s indicated coal deposits in several provinces. More detailed coal surveys are needed to fully assess Cambodia's coal reserves. One particular deposit in Stung Treng Province is estimated at 7 million tons of coal. This can aid in alleviating Cambodia's energy needs if it can be successfully exploited. Feasibility studies on this issue are still needed.³⁹

Another, more promising, alternative resource for energy available to Cambodia is hydropower. Based on estimates made by the UN in 1995, Cambodia has a potential

³⁷ CIA, *The World Factbook: Brunei*; APEC, *APEC Energy Demand and Supply Outlook 2006: Brunei Darussalam*, 7-10.

³⁸ Central Intelligence Agency, *The World Factbook: Cambodia*, "Geography, People, Government and Economy Information," (2009), <https://www.cia.gov/library/publications/the-world-factbook/> (accessed February 9, 2009).

³⁹ United Nations, "Draft: Cambodia Energy Sector Strategy," 8.

hydropower capacity of 10,000 MW. Current hydropower developments are nowhere near this level. The most significant hydropower plant in Cambodia is a Chinese run plant with the capacity of 12 MW. The remainders of Cambodia's installed hydropower plants are small-scale, mini-hydro plants with generation capabilities only in the kilowatt range. If effectively developed, Cambodia can meet all its electricity demands for several decades through hydropower. Energy shortages will become an issue for sustaining development if it is not addressed. With such potential, Cambodia has focused its future energy generation efforts in hydropower instead of nuclear energy with a planned increase in generation capacity of about 1190 MW by the timeframe 2020. This is only 12% of the total estimated hydropower potential in Cambodia.⁴⁰

3. Timor-Leste

Timor-Leste may have had a small change in fortune with the discovery of offshore oil and natural gas reserves. Like many of its neighbors, Timor-Leste does not have refining capability. It is exporting these resources to its neighbors for revenue and not using them directly for electricity production. In 2005, it established a petroleum fund as the repository for its newfound source of income in order to preserve this wealth for the future.⁴¹

Although revenue is not an alternative energy resource, it can indirectly contribute to providing energy for the populace as payment for fuel and infrastructure repairs. The World Bank recognizes the need to inject much needed aid and assistance into Timor-Leste's energy services and is working on a grant for that purpose. Timor-Leste is completely dependent on imported diesel for electricity and will remain so for some time into the future because of the lack of infrastructure. Earned revenue and grants can go towards buying energy for now and rebuilding the necessary infrastructure to deliver energy to the people.⁴² Timor-Leste does have available alternatives to nuclear energy in its newly-found natural gas and oil reserves off its coast. However, it still lacks the

⁴⁰ United Nations, "Draft: Cambodia Energy Sector Strategy," 6; Lim and Ponnarath.

⁴¹ CIA, *The World Factbook: Brunei*.

⁴² The World Bank, *Project Paper on a Proposed Grant in the Amount*, 1-6.

infrastructure and generation facilities to utilize these fuels. It will be some time before these resources can be used to directly supply electricity to Timor-Leste, but it will take less time than pursuing a nuclear energy program for electricity.

4. Laos

This underdeveloped country is very rich in hydropower potential, even more so than its neighbor, Cambodia, because of its mountainous geography.⁴³ The exploitable potential for Laos' hydropower resources is 23,000 MW and well beyond its domestic needs. Hydropower accounts for 98% of Laos' total electricity production capability. The Lao PDR realized the benefits of their indigenous hydropower potential and made plans to expand their hydropower industry.⁴⁴ Less than 2% of their hydropower potential has been tapped by installed hydropower plants.⁴⁵ Current hydropower capacity in the Lao PDR is 671 MW and expanding. Between 2001 and 2010, Laos plans on bringing six hydropower plants on line for a total capacity increase of about 360 MW with the assistance of Chinese hydropower companies.⁴⁶ The timeline for these six plants have fallen behind schedule but not enough to threaten Laos' energy security.⁴⁷ Even with the current hydropower projects, Laos' hydropower potential will still be largely untapped. Laos' hydropower is an abundant available alternative to nuclear energy that incorporates less risk.

5. Singapore

Being a city-state, Singapore has no energy resources indigenous to its very small sovereign landmass. It imports everything that it consumes in terms of energy resources. Its electricity generation capacity matches its current demand with a 10% margin. It recently shifted from reliance on oil for electricity production to natural gas in order to

⁴³ CIA, *The World Factbook: Laos*.

⁴⁴ Pholsena and Phonekeo, 4–6.

⁴⁵ Somvichith.

⁴⁶ Vongsiry and Vanlasy.

⁴⁷ Somvichith.

alleviate its dependence on oil.⁴⁸ Singapore's proximity to natural gas abundant Malaysia and Indonesia makes this form of energy ideal for Singapore's electricity needs.⁴⁹ Singapore has no indigenous available alternative energy sources, but sits astride the transport route of oil and natural gas in the region. While this makes Singapore's access to natural gas diversified and reliable, it does nothing to alleviate its dependence on imported energy resources. All these factors together contribute to make nuclear energy more favorable to Singapore, if for no other reason than to relieve dependency on external fossil fuel.

D. POLITICAL WILL

The endeavor to develop nuclear energy will require state sponsorship, which requires that states commit to effectively and competently running a complex technical program. This commitment is normally embodied in the form of a government agency responsible for nuclear energy actions. The more committed countries have well developed government agencies with the adequate level of administrative and technical capability to get the job done. This commitment often also requires the support of the populace and/or significant actors in a nation's political arena. This includes politicians, activist/interest groups and any other entities that have a voice in government (these issues will become more significant in later cases). Political will is also affected by electricity demand and available alternatives. Together these two factors create a sense of need within the country. Political actors evaluate this need with other national interests or in some cases with their own interests. Together all these things form political will for nuclear energy. In the case of the five countries addressed in this chapter, only Brunei and Singapore have demonstrated effective political will over time to hold the course necessary on large-scale technical activities. It is questionable whether Cambodia, Timor-Leste and the Lao PDR have sufficient political will to translate such a complex technical goal into reality. Political turmoil, lack of government effectiveness,

⁴⁸ Central Intelligence Agency, The World Factbook: Singapore, "Geography, People, Government and Economy Information," (2009), <https://www.cia.gov/library/publications/the-world-factbook/geos/id.html> (accessed February 9, 2009).

⁴⁹ APEC, *APEC Energy Demand and Supply Outlook 2006: Singapore*, 85–89.

insufficient infrastructure, and other inefficiencies rob the political will for anything beyond rudimentary infrastructure development in Cambodia, Timor-Leste and the Lao PDR. For these Southeast Asian countries, mustering the political will to pursue nuclear energy is presently unachievable. The hydropower programs in Cambodia and Laos are trials that can be used to assess if these two countries can muster sufficient political will to accomplish a medium level technical endeavor. This may be the first step in fortifying the political will of these two countries. For Brunei and Singapore, the analysis of political will needs to focus on whether each state has the necessary administrative infrastructure to pursue nuclear energy, and what political reason drives the state's decision against pursuing it.

1. Brunei

In 2002, energy companies in Brunei established the Brunei Energy Association (BEnA) to direct and shape Brunei's energy industry, and promote conservation and efficiency in energy use. Although it is a business group, it has close ties to the government: its "honorary adviser" is the minister of energy, and its "honorary president" is the deputy minister of industry and primary resources.⁵⁰ In 2007, the Association invited South Korean energy experts to discuss the prospects for nuclear energy in Brunei. Norizah Harun Taylor, the BEnA's spokesperson for this September 2007 meeting, stated that it is unlikely that Brunei will pursue nuclear energy in the foreseeable future, but she said the country will continue to explore alternative forms of energy for when oil reserves run dry.⁵¹ The fact that BEnA was evaluating the nuclear energy issue indicates a sincere interest in determining applicability and feasibility for the sultanate. Since Brunei has not signaled anything more than initial interest, the nuclear debate there has not drawn significant attention. No advocates or opponents to nuclear energy in Brunei have come forth to defend their views. Brunei has no political will to pursue nuclear energy because the costs and risks would be difficult to justify with the large indigenous oil and gas reserves.

⁵⁰ Brunei Energy Association, <http://www.bena.org.bn/> (object name Profile; accessed February 9, 2009).

⁵¹ Salam, "BEna to Host Forum on Nuclear Energy."

2. Cambodia

Cambodian Prime Minister Hun Sen announced in September 2008 that nuclear energy was “a long distance away for us, but this is our goal.”⁵² This is a clear indicator that Cambodia wants to keep the option of future nuclear energy development open but realizes its present limitations. The fact that no substantial government effort has gone into this issue and no state entity has been established or assigned responsibility for nuclear energy is a sign that Cambodia lacks the political will to pursue nuclear energy. This statement does not conflict with Cambodia’s current energy policy of expanding electrification and electricity production based on hydropower sources. The availability of alternatives contributes to Cambodia’s political decision to abstain from nuclear energy at present. The government is focused on the more convenient solution that hydropower offers because it does not need the level of administrative and technical effort necessary in a nuclear energy program.

3. Timor-Leste

No political will to pursue nuclear energy exists in Timor-Leste. The fledgling government of Timor-Leste is focused on fundamental infrastructure and restoring basic services like security, electricity and water as rapidly as possible, and cannot be bothered with ventures requiring such high startup costs. The current government structure has no agency responsible for such a technically complex endeavor.

4. Laos

The Lao PDR has not made any statements of intent concerning nuclear energy development; however, the Lao vice Prime Minister, Bounhang Vorachith, defended the national sovereignty of every country to pursue peaceful nuclear energy in the face of global energy pressures.⁵³ Like its Cambodian neighbor, the leaders of the Lao PDR are

⁵² Ker Munthit, “Cambodia Eyes Nuclear Plant for Electricity,” *Associated Press*, September 28, 2008, www.ap.org/ (accessed December 30, 2008).

⁵³ Geoffrey Gunn, “Southeast Asia’s Looming Nuclear Power Industry,” *The Asia-Pacific Journal: Japan Focus*, posted on February 11, 2008, [http://www.japanfocus.org/ Geoffrey Gunn-Southeast Asia s Looming Nuclear Power Industry](http://www.japanfocus.org/Geoffrey_Gunn-Southeast_Asia_s_Looming_Nuclear_Power_Industry) (accessed January 15, 2009).

more focused on rudimentary development and hydropower rather than nuclear energy. No state agency exists in the Lao PDR to take on the nuclear energy issue, and the Laos Ministry of Energy and Mines (the front agency for Lao energy programs) has not been given this task. Electricity demand and availability of alternatives plays a significant role in shaping Lao's political decision to not consider nuclear energy. All indicators point to a lack of political will to pursue nuclear energy by the Lao PDR leadership because the risk is not worth the gain since hydropower can cover the country's electricity demand for years to come.

5. Singapore

Singapore is a country whose leadership has shown credible political will throughout its history. Singapore stands apart from other Southeast Asia countries in that it has expressed reservations about nuclear energy within the region. These reservations are externally directed and not unfounded. Singapore is susceptible to trans-boundary environmental threats like the Southeast Asian haze resulting from slash and burn land clearing in Indonesia. Such irresponsible behavior, if allowed to penetrate nuclear energy program, may result in a catastrophic event. Singapore is less willing to take on the burden of such an event since it will not reap any of the benefits. In 2007 Singapore's Prime Minister, Lee Hsien Loong, expressed concerns over the region's nuclear energy ambitions. He reiterated that all parties must fully understand the risks involved, and that the regulations and standards must be made clear and strictly adhered to.⁵⁴

As for utilizing nuclear energy for its own electricity need, Singapore is an unlikely candidate but has not completely ruled out the prospects. Singapore's proximity to gas rich Malaysia and Indonesia coupled with its location astride the ocean transit lane between East Asian and the Persian Gulf makes gas and oil power plants ideal.⁵⁵ But its reputation as a "clean" city is pressing Singapore politically to explore alternatives to fossil fuels. The major obstacle to Singapore's interest in nuclear energy stems from the 30 km safety standoff from urban areas. Singapore's limited landmass makes meeting

⁵⁴ Gunn, "Southeast Asia's Looming Nuclear Power Industry."

⁵⁵ Ibid.

this requirement impossible. Singapore contemplated moving to an offshore land reclamation site to meet this requirement, but it was determined that any viable offshore site would be within 30 km of the Malaysian coast. Although the coast may not be considered an urban area, the presence of an offshore nuclear site may be subject to Malaysian criticism and objection. Minister Mentor Lee Kuan Yew has admitted that any attempt at nuclear power by Singapore would entail cooperation with Malaysia in order to be viable.⁵⁶ So in Singapore's case, its political will alone will not be sufficient to press the issue of nuclear energy, as it would have to convince neighboring Malaysia to cooperate and would need to rely on Malaysian politics to see this task through. These limitations on the nuclear energy issue drives Singapore's political will away from such a venture.

E. ADEQUATE MEANS OF PRODUCTION TO DEVELOP NUCLEAR POWER

With the exception of Brunei and Singapore, the countries in this category face a near impossible obstacle to nuclear energy development in the means of production. Nuclear plants must be constructed to withstand the potentially inhospitable environment present in Southeast Asia as well as the torturous operating conditions associated with power generation through fission. This means skilled labor and lots of money. Cambodia, Timor-Leste and the Lao PDR are going to have a difficult time trying to amass sufficient technical labor and capital to pursue nuclear energy because they are generally poor. The issue of adequate means of production to develop nuclear energy is also an application of opportunity costs. It would be nearly impossible to justify investment in nuclear energy when the payoffs from pouring those same resources into other pressing issues would have a more immediate and significant impact. With the onset of the current global recession (2009), opportunity cost for these three countries becomes even larger. Since available capital will become scarcer, efficient and effective

⁵⁶ Lee Kuan Yew, Transcript of Minister Mentor Lee Kuan Yew's Dialogue with Singapore Energy Conference on November 4 2008, Raffles City Convention Centre, <http://www.news.gov.sg> (accessed November 19, 2008).

use of it becomes that much more important. For this reason, the available means to develop nuclear energy in Cambodia, Timor-Leste and the Lao PDR will not be discussed. Instead, this section will only examine Brunei and Singapore.

1. Brunei

As mentioned previously, Brunei is small but very wealthy. Its GDP per capita is far higher than the average developing countries within the region because of its relatively low population and relatively high oil and gas exports. It is not difficult for this country to amass capital. According to the World Bank, Brunei's GDP in 2006 was \$11.6 billion.⁵⁷ The CIA World Factbook estimated Brunei's GDP in purchase power parity (PPP) terms in 2008 at \$20.65 billion.⁵⁸ These numbers are small when compared to other industrial nations but its GDP per capita from the same sources are \$26,930 and \$54,100 respectively. This indicates that this nation has a lot of capital available for investment. Brunei isn't looking to invest in nuclear energy because of its large oil and gas reserves, but the capital is available if it changes its mind.⁵⁹

Brunei is considered an industrialized nation, albeit a small one, because of its oil exports industry, service industry and growing value-added industry. A majority of these industries are technology- and engineering- heavy fields. This indicates that Brunei has a skilled work force capable of handling advanced technological issues and/or has sufficient wealth to outsource problems that cannot be handled indigenously. It is also looking to improve this already competent work force through more training and education funded by its oil and gas revenues.⁶⁰ All this would suggest that Brunei has sufficient labor resources to pursue something as technical as nuclear energy if it chooses.

⁵⁷ The World Bank, "Key Development Data and Statistic," *The World Bank Data and Statistic*, <http://www.worldbank.org/data/countrydata/countrydata.html/> (accessed February 23, 2009).

⁵⁸ CIA, *The World Factbook: Brunei*.

⁵⁹ DOE, "Country Analysis Brief: Brunei."

⁶⁰ CIA, *The World Factbook: Brunei*.

2. Singapore

Like Brunei, Singapore's GDP in total dollar amount does not significantly draw attention, but when broken down to a per capita value, it speaks volumes at \$52,900 in 2008.⁶¹ Singapore has built its economy not based on natural resource wealth but on geographic location and sound financial policies. It is strategically located at the mouth of the Straits of Malacca, the predominant sea route between Asia and Europe and the Middle East. This strategic location coupled with its savvy financial policies made Singapore an ideal entrepot in Southeast Asia. And as such, it has sufficient capital to invest in large technical projects such as nuclear energy. Other mitigating factors have precluded Singapore from making such an investment.

Along with sufficient capital, Singapore also has a technically advanced work force of medium to high skill laborers. Singapore's industries include technology- and engineering- heavy fields such as: oil refinement, petro-chemical production, consumer electronics, information technology, pharmaceuticals and medical technology. The presence of these industries run by Singapore's relatively small work force is an indicator of how rich this country is in medium and high skilled labor. It would not be difficult for Singapore to muster the necessary technical labor to pursue a nuclear energy project if it overcame political hurdles and its land constraints.

F. TECHNICAL CAPACITY

The technical capacity aspect of nuclear power goes beyond obtaining medium and high skilled labor for the construction of a nuclear power plant. It deals with the knowledge, proficiency and training of the operators and administrators to run a nuclear program safely. Acquiring and maintaining these skill sets in Southeast Asia requires significant investment in human capital on the part of the state and its public. Legions of scientists, engineers and administrative bureaucrats trained in the nuclear field must be either grown or outsourced. Outsourcing an entire nuclear energy program is inconceivably expensive and unrealistic. This leaves building the capability

⁶¹ CIA, *The World Factbook: Singapore*.

domestically. Outside help in establishing this technical capacity is not unrealistic and will be the most likely method by which a country acquires this capability. A country is more likely to pursue nuclear energy when it has higher levels of technical capacity.

Of the five countries evaluated in this chapter, it is obvious that Timor-Leste does not have the technical capacity to pursue nuclear energy based on the current conditions of this emerging country. The complete absence of technical/professional or advanced academic communities within Timor-Leste is a sign that it has significant ways to go before looking into such ventures.⁶² Cambodia and Laos present a different scenario. Both countries are relatively poor and underdeveloped, but both countries are also undergoing major infrastructure development projects dealing with energy as discussed in the section on availability of alternatives.⁶³ The experience and benefits in building a hydropower program and electrification projects throughout the country will improve the skill sets for maintaining and operating complex technical programs. That experience coupled with adequate training from technology holders and/or the IAEA can result in sufficient technical capacity. At present, none of these countries possesses the technical capacity for nuclear energy because they have not acquired the know-how from the IAEA or other technology holders and have yet to prove themselves with their hydropower programs.

A good indicator of whether or not a country has invested in technical capacity for nuclear energy is an evaluation of the technical cooperation projects that country has undertaken with the IAEA. At present, Brunei, Timor-Leste, Cambodia and Laos have not participated in the IAEA's Technical Cooperation (TC) program.⁶⁴ This is another independent indication that these countries do not have the technical capacity to pursue nuclear energy. The IAEA is internationally recognized as the custodian of nuclear technology for peaceful applications. When dealing with technology that can spiral to

⁶² The World Bank, *Project Paper on a Proposed Grant in the Amount*; CIA, *The World Factbook: Brunei*.

⁶³ CIA, *The World Factbook: Cambodia and Lao*; United Nations, "Draft: Cambodia Energy Sector Strategy;" Pholsena and Phonekeo; Somvichith.

⁶⁴ International Atomic Energy Agency (IAEA) database, <http://www-TC.project.iaea.org/TCprojectweb/default.asp> (object name Department of Technical Cooperation; accessed July 25, 2008).

applications involving weapons of mass destruction, obtaining that technology legitimately and through channels with respected safeguards is the only way to avoid international scrutiny and negative attention. In the case of these four countries, it is very unlikely that they would have pursued other less scrupulous avenues of acquiring technical capacity for nuclear energy, making the IAEA their primary source if they were looking to pursue nuclear technology.

Singapore is the only country of the five in this chapter who has participated in the IAEA's TC program. It has completed or is currently participating in 26 TC projects, 17 of which are essential for nuclear energy application. Of those 17, the majority deals with nuclear and atomic physics, which has other academic applications beyond nuclear energy. Singapore has not participated in any TC projects that would train its people to handle the nuclear fuel cycle or waste management, a field critical to any nuclear energy program.⁶⁵ The combination of the IAEA TC projects in which Singapore has participated indicates that this technologically advanced country has not invested itself in acquiring the technical capacity to pursue nuclear energy. This is to say that, at present, Singapore does not have sufficient technical capacity for developing a nuclear energy program. Based on the level of technical competence Singapore has demonstrated, it could develop the technical capacity for nuclear energy in very short order if it chooses.

G. INTERNATIONAL SUPPORT

All Southeast Asian countries have accepted that nuclear energy requires significant amounts of technical knowledge and resources. For those countries not pursuing nuclear energy, international support for the development of nuclear energy is irrelevant. However, all these countries with the exception of Timor-Leste are members to the Nuclear Nonproliferation Treaty (NPT), the IAEA safeguards and additional protocol, and the Bangkok treaty establishing a Southeast Asia nuclear weapons free zone (SEANWFZ). All five countries are a signature to the Comprehensive Test Ban Treaty

⁶⁵ International Atomic Energy Agency (IAEA) database.

(CTBT).⁶⁶ The significance of keeping with this international norm of nonproliferation is that it puts these countries in good stead with the IAEA and international assistance for nuclear energy development, if it were to be pursued, would be more forthcoming. Regardless of whether the international community is willing or unwilling to provide technical assistance pertaining to nuclear energy, the five countries in this chapter for one or more reasons have decided that they are not interested.

It is important to recognize that South Korea has already demonstrated a willingness to cooperate with Brunei in the nuclear energy field when Brunei showed interest. In September 2007, Brunei hosted a forum to discuss applicability of nuclear energy and invited South Korean experts to discuss safety, processes, reliability, supply and feasibility of nuclear energy.⁶⁷ South Korea is a regional nuclear energy user who is looking to develop an exportable nuclear industry. Japan is pursuing the same goal.⁶⁸

H. CONCLUSION OF EACH COUNTRY'S DECISION

The combination of the six factors analyzed for the five countries that have abstained from nuclear energy clarifies the basis of their decisions. Some factors dominated over others in different countries and each arrived at their own decision based on the impacts of these factors.

1. Brunei

Brunei's electricity demand is relatively small and at present is well within its electricity production capacity from an indigenous source of natural gas.⁶⁹ Brunei is

⁶⁶ United Nations (UN), "Status of Multilateral Arms Regulation and Disarmament Agreements," United Nations Office of Disarmament Affairs (UNODA), <http://disarmament.un.org/TreatyStatus.nsf> (accessed April 3, 2009); International Atomic Energy Agency, *Nuclear Safeguards and Verification*, http://www.iaea.org/OurWork/SV/Safeguards/sg_protocol.html (accessed April 3, 2009); Association of Southeast Asian Nations, *Treaty on the Southeast Asia Nuclear Weapon-Free Zone Bangkok, Thailand*, 1995, <http://www.aseansec.org/2082.htm> (accessed April 2, 2009); Comprehensive Nuclear-Test Ban Treaty Organization, Member States, Status of Signature and Ratification database, http://www.ctbto.org/member-states/?no_cache=1 (accessed April 1, 2009).

⁶⁷ Salam.

⁶⁸ Gunn, "Southeast Asia's Looming Nuclear Power Industry."

⁶⁹ CIA, *The World Factbook: Brunei*.

facing increasing energy pressures caused by increased urbanization⁷⁰ and expansion of the country's industry toward value-added goods and services.⁷¹ However, the expected growth in electricity demand for the next two decades is still well within the nation's planned energy sector expansion. Brunei has an abundance of natural gas as an alternative to nuclear energy for electricity. It is estimated that Brunei's natural gas reserves is capable of absorbing the expected growth in demand and will last well beyond 2030.⁷² Low to moderate electricity demand coupled with abundant availability of alternatives present Brunei with a clear reason to abstain from nuclear energy.

2. Cambodia

Cambodia's primary electricity demand problem is its lack of distribution infrastructure followed by generation capacity as a lesser problem. Its poor infrastructure makes the cost of electricity in Cambodia one of the highest in the region.⁷³ At present, Cambodia is focused on development of hydropower because of its capacity and inexhaustible/renewable nature. The hydropower potential alone in Cambodia is sufficient to meet future electricity demands projected at the pre-recession rates for the next couple of decades. This could resolve Cambodia's electricity production problem but does nothing for the infrastructure issue. In terms of opportunity costs, Cambodia's means of production (capital and labor) would be better spent on hydropower, than on pioneering nuclear energy. Cambodia surely cannot do both. The combination of low energy demand, readily available alternatives, and limited means of production makes it highly unlikely that Cambodia will reverse its decision to abstain from nuclear energy.

⁷⁰ CIA, *The World Factbook: Brunei*.

⁷¹ APEC, *APEC Energy Demand and Supply Outlook 2006: Brunei Darussalam*, 7-10; DOE, "Country Analysis Brief: Brunei."

⁷² CIA, *The World Factbook: Brunei*; APEC, *APEC Energy Demand and Supply Outlook 2006: Brunei Darussalam*, 7-10.

⁷³ United Nations, "Draft: Cambodia Energy Sector Strategy," 5-14.

3. Timor-Leste

Timor-Leste is still plagued with chaos and political instability from its birth as an independent nation a decade ago. Little political will exists for anything other than rebuilding the country's basic infrastructure. Like Cambodia, Timor-Leste's electricity demand problem is not one of production but of distribution infrastructure. Both countries rely almost entirely on imported diesel to power small generators attached to inefficient grids. So like Cambodia, the cost of electricity in Timor-Leste is one of the most expensive within the region.⁷⁴ Although oil and natural gas have recently been discovered in Timor-Leste waters, the benefits of this alternative energy source will most likely come in the form of revenue and will not be realized for some time.⁷⁵ The Dili government is focused on fundamental infrastructure and basic state reconstruction, and will most likely look to those revenues to do so. Little capital and labor will be left over for projects that do not immediately alleviate the dire conditions in Timor-Leste, let alone a program like nuclear energy. Timor-Leste is lacking in all factors to pursue nuclear energy, the most significant of which is the lack of political will resulting from a tenuous fledgling government.

4. Laos

Laos's relatively small electricity demand compared to its expanding hydropower based generation capacity means that it does not need to consider nuclear power as an alternative source of energy.⁷⁶ Domestic electricity consumption is growing at a manageable rate as urbanization rates are low and Laos's primary industry is resource extraction which is not electricity heavy. Hydropower plants produce enough electricity for domestic use and for export to its neighbors.⁷⁷ Laos is looking to capitalize on its hydropower resource and has initiated plans to expand its hydro-electric capacity.⁷⁸ In

⁷⁴ The World Bank, *Project Paper on a Proposed Grant in the Amount, 2*.

⁷⁵ CIA, *The World Factbook: Brunei*.

⁷⁶ Somvichith.

⁷⁷ Pholsena and Phonekeo, 5; CIA, *The World Factbook: Laos*.

⁷⁸ Somvichith.

the case of Laos, low electricity demand and ready availability of an alternative energy source are the main drivers in its decision to abstain from nuclear energy.

5. Singapore

Singapore is a unique case among the five countries in this chapter. Its electricity demand profile supports seeking a reliable large-scale electricity source like nuclear power⁷⁹ and it has no viable, indigenous alternatives. It is a rich industrialized country with a history of technical cooperation with the IAEA, so it has sufficient means of production and could rapidly gain the technical capacity if it so chooses. International support would most likely be forthcoming if Singapore were to pursue the endeavor of nuclear energy. Singapore's major obstacle to nuclear energy is its inability to comply with a 30 km safety standoff range between nuclear power plants and urban areas. This limitation results in a political issue that cannot be resolved without coordination and cooperation from Singapore's neighbor Malaysia.⁸⁰ At present, Singapore does not have the political will to pursue nuclear energy. Singapore has also demonstrated anxiety about its neighbors developing nuclear energy and its susceptibility to trans-border environmental issues.

6. Closing Summary

In this section, the factors of electricity demand, availability of alternatives, and adequate means of production played more significant roles than their counterparts. The main energy problem in Cambodia, Laos, and Timor-Leste is a lack of infrastructure to distribute electricity. Additional generation capacity from nuclear energy would be nearly useless until a more comprehensive distribution network is established and infrastructure is improved. These three countries also lack sufficient means of production to spend on such a high cost of entry project. What little capital and skilled labor these countries have would be better spent on constructing and managing a distribution system and infrastructure than on developing a nuclear energy capability. Cambodia, Laos,

⁷⁹ APEC, *APEC Energy Demand and Supply Outlook 2006: Singapore*, 85–89.

⁸⁰ Lee Kuan Yew.

Brunei and eventually Timor-Leste have available alternative energy sources. Brunei and Singapore are the only ones with sufficient means of production available for nuclear energy endeavors, but have overwhelming reasons to not pursue it.

Political will and technical capacity, although important, play only secondary roles. Political will was heavily influenced by the three dominant factors discussed in the previous paragraph. Because these countries had decided to abstain for sound reasons, there was little public debate in any of them. No political actors in these countries weighed in on this issue. Without influences beyond need, a combination of electricity demand and available alternatives, political will behaved like a dependent variable and followed need. Although the five countries in this category vary in degree of authoritarianism, they all complied with the pragmatic needs of their populace, a similarity the global community may find relieving. In other countries to be assessed later, political will may play a more aggressive or significant role, and may be contrary to some public views. All five countries lack sufficient technical capacity to pursue nuclear energy, but Singapore could acquire it in relatively short order. This stands in contrast to Cambodia and Laos and in very sharp contrast to Timor-Leste. Brunei sits somewhere in between Singapore and the others in technical capacity, but it is closer to Singapore than the others. The factor of international support had very little relevance to these five countries since the dominating factors overwhelmingly drive them to not pursue nuclear energy.

	Electricity Demand	Available Alternatives	Political Will	Means of Production	Technical Capacity	International Support
Brunei	Small with expected growth within production capacity*	Abundance of natural gas*	None	Adequate capital Adequate labor	Inadequate technical capacity	None received, but South Korea has demonstrated eagerness to assist if interest grows
Cambodia	Small and lacks a robust distribution system*	Abundance of hydropower*	None, but has proclaimed it as a long-term future goal	Lacking in available capital and skilled labor*	Inadequate technical capacity	None
Timor-Leste	Small with no effective distribution system*	Newly discovered oil and natural gas (not yet exploitable for domestic use)*	None	Lacking in available capital and skilled labor*	Inadequate technical capacity	None
Laos	Small and lacks a robust distribution system*	Abundance of hydropower*	None	Lacking in available capital and skilled labor*	Inadequate technical capacity	None
Singapore	Large demand and growing	No available alternatives	None because of inability to meet the 30 km safety standoff distance*	Adequate capital Adequate labor	Inadequate technical capacity with the potential to rapidly acquire it	None

(*) The dominating factor in a country's decision on nuclear energy.

Table 1. Factors in Countries That Have Abstained From Nuclear Power

THIS PAGE INTENTIONALLY LEFT BLANK

III. COUNTRIES THAT MAY POTENTIALLY PURSUE NUCLEAR ENERGY IN THE NEAR FUTURE

A. INTRODUCTION

Burma, Malaysia and the Philippines have the potential to be the next countries in Southeast Asia to seriously consider pursuing nuclear energy. At present, these countries are not developing a nuclear energy program, but circumstances in each country are bringing them closer to it. Burma has announced its intention to develop a research reactor in order to study nuclear technology for future applications in energy generation.⁸¹ Malaysia has an “emerging interest” in nuclear energy and may review the decision to pursue it again in the following decade.⁸² The Philippines reviews its position on nuclear energy every time a new president enters office, and so far has maintained the status quo against using nuclear energy.⁸³ The six factors affecting the decision on nuclear energy will provide insight into the question of nuclear energy for these countries. Burma and Malaysia have made it clear that they intend to explore the possibilities of nuclear energy in the next couple of decades and will most likely start a nuclear energy program of some sort. The Philippines has a firm position against the use of nuclear energy based on problems with the Bataan Nuclear Power Plant (BNPP), but mounting energy pressures are forcing it to re-evaluate this position.

⁸¹ Bertil Lintner, “Burma’s Nuclear Temptation,” *Yale Center for the Study of Globalization* (2008), <http://yaleglobal.yale.edu/display.article?id=11673> (accessed March 13, 2009); Geoffrey Gunn, “Southeast Asia’s Looming Nuclear Power Industry,” *The Asia-Pacific Journal: Japan Focus*, posted on February 11, 2008, <http://www.japanfocus.org/Geoffrey-Gunn-Southeast-Asia-s-Looming-Nuclear-Power-Industry/> (accessed January 15, 2009).

⁸² Nuclear Malaysia Database, http://www.nuclearmalaysia.gov.my/index.php?option=com_ (object name NUCLEAR POWER PLANNING & PROSPECTS IN MALAYSIA AND SOUTHEAST ASIA Power Point Presentation; accessed March 16 2008).

⁸³ Adrian Addison, “Philippines revisits nuclear energy option at ‘white elephant’ plant,” *Agence France-Presse*, Jan 8 2009, <http://www.google.com/hostednews/afp/article/ALeqM5hRygaTl6gQqsVyidfyOxyOrBgE4A> (accessed January 16, 2009); Raymund Jose Quilop, “Using Nuclear Energy: A Philippine Experience,” Council for Security Cooperation in the Asia Pacific (CSCAP): Nuclear Transparency in the Asia Pacific, http://www.cscap.nutrans.org/Nuc_Trans/locations/philippine-june10/philippine.htm (access January 16, 2009).

The need for nuclear energy can be assessed in two parts, electricity demand and the supply of available alternatives. These two factors are closely related and had a profound impact on the factor of political will in the previous chapter. Need still play a part in political will in the three countries analyzed in this chapter, but other domestic factors specific to each country will play a larger role in shaping political will. The means of production and the technical capacity of these countries are relatively transparent in favor of or against nuclear energy. International support comes down to transparency as the gate keeper to availability of assistance from technology holders.

B. ELECTRICITY DEMAND

Gauging electricity demand is the first part of assessing the need for nuclear energy. As in the countries discussed in the previous chapter, electricity demand in these countries is driven by increased urbanization, commerce, value-added industries and manufacturing. The ability to meet rising demand for electricity is an essential element in maintaining growth and development in these countries, and is a vital goal for their respective governments. Nuclear energy can help meet electricity demand in these countries by providing a large-scale energy solution to the generation problem and relieve fossil fuel dependency. The larger a country's electricity demand, the more it is likely to favor adopting nuclear power to break the dependency on fossil fuels for electricity generation.

1. Burma

The CIA World Factbook estimates that Burma's electricity generation capacity is about 30% greater than its consumption rate.⁸⁴ Yet, the Burmese public is still facing tremendous energy pressures. This gap in supply and demand exists because the distribution system is not well developed and is not sufficient for Burma's populace. The Burmese government does nothing to alleviate this pressure because it does not place a high priority on improving the lives of the general public and uses this gap as a means to

⁸⁴ Central Intelligence Agency, *The World Factbook: Burma*, "Geography, People, Government and Economy Information," (2009), <https://www.cia.gov/library/publications/the-world-factbook/geos/id.html> (accessed March 11, 2009).

control the country by suppressing those who do not support the regime. This principle was illustrated by the protests and subsequent crackdown in 2007. This incident started as a protest over an unforeseen increase in fuel (gas and diesel) prices imposed by the government.⁸⁵ New electricity generation and distribution infrastructure was built in support of the military government's move to Naypyidaw in 2006.⁸⁶ Burma is continuing to expand its electricity generation capacity, and strives to become a regional energy exporter to electricity hungry neighbors. As of 2008, Burma's installed generation capacity was 1719.9 MW and its peak usage was 1061.2 MW.⁸⁷ Unfortunately, the benefits of nuclear energy for large scale electricity production will only reach those loyal to the Junta government.

Burma has a large agricultural base and continues to rely on agriculture as a significant source of income.⁸⁸ This trend does not promote urbanization and commercial services. Poor farmers are less likely to eat in restaurants, use a lot of electricity based consumer products and shop in department stores. This means the electricity demand from residential and commercial sectors are not expected to grow significantly. The repressive political atmosphere resulting from the Junta's authoritarian government discourages foreign direct investments (FDI) outside of government-sponsored projects, and the economic policy known as the *Burmese way to Socialism* stifles indigenous private entrepreneurs. These two conditions limit the level of effective industrialization, minimizing the growth of value-added industry and manufacturing outside of the Junta's control. As a result of Burma's control-centric state, it has a low urbanization rate, a small commercial sector, and limited industry in the private sector.

⁸⁵ "Hundreds Protest in Myanmar Over Fuel Price Hike," *Forbes*, August 19, 2007, <http://www.forbes.com/afxnews/limited/feeds/afx/2007/08/19/afx4033455.html> (accessed December 29, 2008); Seth Mydans, "Tens of thousands join Myanmar protest," *International Herald Tribune*, September 24, 2007, <http://www.iht.com/articles/2007/09/24/news/myanmar.php> (accessed December 29, 2008); Seth Mydans, "Myanmar monk protest contained by Junta forces," *The New York Times*, September 28, 2007, <http://www.nytimes.com/2007/09/28/world/asia/28cnd-myanmar.html> (accessed December 29, 2008).

⁸⁶ Burma River Network database, <http://www.burmariversnetwork.org/> (object name "Upper and Lower Paunglaung Dams," accessed March 10, 2009).

⁸⁷ Burma River Network database, <http://www.burmariversnetwork.org/> (object name *Country Report on Progress of Power Development Plans and Transmission Interconnection Projects: Myanmar* power point presentation, November 21, 2008; accessed March 13, 2009).

⁸⁸ Central Intelligence Agency, *The World Factbook: Burma*.

This makes Burma's electricity demand small. The shortage of electricity experience by the general public is centered on distribution limits imposed by the Junta and not by generation capacity. Nuclear energy will not solve the underlining cause of this gap, but the Junta government may still decide to pursue it for their own nefarious ends.

2. Malaysia

Malaysia's future electricity demand is driven by strong growth in the industrial and the residential sectors. The electricity demand increase in industry originates from Malaysia's shift from energy-intensive to non-energy-intensive industries. Non-energy-intensive industries tend to be more value-added industries, which use more electricity than other energy sources (oil, natural gas, steam, etc.). As Malaysia's "economy moves further up the value-added production chain"⁸⁹ and takes this next-step in industrialization, the urbanization rate goes up and the general standard of living improves. This trend drives residential electricity consumption up with increased demands for appliances such as refrigerators and air-conditioners. A counter effect to this driver of electricity demand is improved efficiency in these appliances. This counter is only significant enough to slow the rate of rising electricity consumption, not reverse it because of the high rate of urbanization. Malaysia's electricity demand is growing with the country's continued development while its natural gas reserves are shrinking. It is looking to coal to carry the near-term future load of electricity generation while exploring alternatives to meet the long-term demand.⁹⁰ From this point of view, Malaysia's electricity demand favors a decision to pursue nuclear energy.

3. The Philippines

Electricity demand in the Philippines is significant and growing. The Philippines has already committed to nuclear energy once in the past under the Marcos regime during

⁸⁹ Central Intelligence Agency, *The World Factbook: Malaysia*, "Geography, People, Government and Economy Information," (2009). <https://www.cia.gov/library/publications/the-world-factbook/geos/id.html/> (accessed March 13, 2009).

⁹⁰ Asia-Pacific Economic Cooperation (APEC), *APEC Energy Demand and Supply Outlook 2006: Malaysia*, Asia Pacific Energy Research Center (Tokyo, 2006), 49–53, <http://www.ieej.or.jp/aperc/outlook2006.html> (accessed December 23, 2008).

the 1970s oil shock, but turned away from it because of corruption in the construction process and site location in the proximity of a dormant volcano and fault lines. The issue of electricity demand did not improve and aging power generation plants began to fail, resulting in the numerous power blackouts in the 1980s.⁹¹ Today, electricity in the Philippines is supplied primarily by coal (40%), natural gas (30%) and hydropower (16%). This capacity outpaces consumption by about 10%.⁹² Future electricity demand growth in the Philippines is driven by the residential sector, with the commercial and industrial sectors in second and third place. This trend is caused by the social and economic developments centered on the Manila metropolitan area and the resulting urbanization increase.

In 2002, the Philippines was 60% urbanized, by 2030 this number is expected to increase to 76%. Increase in urbanization raises the level of electricity demand by residents. Commercial sector consumption of electricity also goes up as it grows to support the expanding urban residence. Industrial development increased the consumption of electricity as Philippine industry modernizes and increased the use of electrical equipment.⁹³ These electricity demand trends make nuclear energy more appealing as an alternative large-scale source of electricity. For this reason, every administration that has come to power since Aquino has reviewed the country's policy on nuclear energy.

C. AVAILABILITY OF ALTERNATIVE ENERGY SUPPLIES

The second part in assessing the need for nuclear energy is in the supply of alternatives to nuclear energy. If Burma, Malaysia or the Philippines have available

⁹¹ Addison; Mong Palatino, "The Philippines' Failed Nuclear Experiment," *United Press International (UPI) Asia*, July 3, 2008, http://www.upiasia.com/Economics/2008/07/02/the_philippines_failed_nuclear_experiment/6312/ (accessed March 12, 2009).

⁹² Central Intelligence Agency, *The World Factbook: Philippines*, "Geography, People, Government and Economy Information," (2009). <https://www.cia.gov/library/publications/the-world-factbook/> (initially accessed March 13, 2009).

⁹³ Asia-Pacific Economic Cooperation (APEC), *APEC Energy Demand and Supply Outlook 2006: the Philippines*, Asia Pacific Energy Research Center (Tokyo, 2006), 74–78, <http://www.ieej.or.jp/aperc/outlook2006.html> (accessed December 23, 2008).

alternatives to nuclear energy for large-scale electricity production, it may make the pursuit of nuclear energy less urgent. The fewer alternatives a country has, the more likely it will commit to nuclear energy. In similar fashion, as the available alternative gets closer to depletion, the more attractive nuclear energy will become.

1. Burma

Burma is endowed with an abundance of indigenous oil, natural gas, coal and hydropower potential.⁹⁴ The junta has prioritized the majority of these resources for export instead of domestic use, even though the general populace is in dire need of fuel for electricity, cooking needs and transportation. Burma's natural gas exports account for over 40% of its export revenues with energy-hungry Thailand as its major customer.⁹⁵ The revenues from such exports are not going back into state development to relieve the energy pressures of the general populace (no improvements in the electricity distribution system for Rangoon). This trend contributes to Burma's reputation as one of the most corrupt governments in the world.⁹⁶

At present, its available electricity capacity is generated from hydropower (over 50%), natural gas (32%) and geothermal steam (16.5%). Like many of its mainland neighbors (Laos and Cambodia), Burma has many rivers and is rich in hydropower potential. The hydropower potential within the country has not reached its limit and future expansion in hydropower is planned in coordination with India, China and Thailand. Burma has at least 29 dam projects under construction with its partners. The additional generation capacity from these combined projects will add 19,413.8 MW to the existing 1,719.9 MW. This is an increase of over ten times the current capacity, all from hydropower. And since hydropower is considered renewable, Burma will be able to sustain this generation capacity nearly indefinitely, as long as it invests in infrastructure

⁹⁴ Joint United Nations Development Programme and the World Bank Energy Sector Assessment Program, *Burma Issues and Options in the Energy Sector*, Report No. 5416-BA, 1985.

⁹⁵ U.S. Department of State Databases, <http://www.state.gov/r/pa/ei/bgn/35910.htm> (object name Background Note: Burma; accessed March 13, 2009).

⁹⁶ Transparency International, 2008 Corruption Perception Index, http://www.transparency.org/policy_research/surveys_indices/cpi/2008 (accessed 29 April 2009).

maintenance. No expansion in other forms of electricity generation is planned.⁹⁷ Couple this with Burma's largely rural population and it is easily assessed that Burma's electricity generation capacity will continue to outpace its demand, even in light of its plans to export energy. Burma could easily solve the energy issues for its people if it chose to do so. The alternatives to nuclear energy available to Burma are abundant and more cost effective should Burma decide to tap into them for electricity for its general populace. This factor should greatly reduce Burma's interest in nuclear energy.

2. Malaysia

Malaysia's available alternatives to nuclear energy are natural gas and coal. Oil's share of electricity production was reduced in the 1990s and gas was made the primary source of electricity generation. In 2010, it is expected that natural gas will account for 56% of electricity generation and coal for 36%. By 2030, coal is expected to surpass natural gas as the primary means of electricity generation. This transition is in response to predictions that natural gas reserves in Malaysia will be depleted by 2038 at the 2005 consumption rate. With the current outlook on natural gas depletion, coal-based electricity was expected to fill the role as the primary electricity producer for the decades to come.⁹⁸ Coal demand in Malaysia is fastest growing of the fossil fuels, and will make Malaysia more reliant on imported coal. Malaysia is already a net importer of coal to make up for the gap in indigenous production. The plan to make coal the primary source of electricity is on shaky ground as indicated by the jump in the price of coal in June of 2008.⁹⁹

In anticipation of rising demand and declining supply, Malaysia has initiated conservation policies coupled with policies to developing renewable energy sources that are reliable and cost-effective.¹⁰⁰ In 2006, the Malaysian Prime Minister stated that the

⁹⁷ Burma River Network database, *Country Report on Progress of Power Development Plans and Transmission Interconnection Projects*.

⁹⁸ APEC, *APEC Energy Demand and Supply Outlook 2006: Malaysia*, 49–53.

⁹⁹ Sarban Singh, "Malaysia to Use Nuclear Energy by 2023," *The Star Online*, September 20, 2008, <http://thestar.com.my/news/story.asp?file=/2008/9/20/nation/2080863&sec=nation> (accessed 16 Mar 2008).

¹⁰⁰ APEC, *APEC Energy Demand and Supply Outlook 2006: Malaysia*, 49–53.

government of Malaysia will reduce dependence on fossil fuels and increase the use of renewable energy sources.¹⁰¹ The limited availability of Malaysia's alternative does buy it time, and makes a large-scale energy alternative important but not urgent. Malaysian officials have stated that at present there is no need for civilian nuclear energy.¹⁰²

3. Philippines

As alternatives to nuclear energy, the Philippines has limited amounts of oil, natural gas and coal, with natural gas and coal as the current fuels of choice. By 2010, APEC expects coal to account for 40% of the Philippines' electricity production and natural gas for 30%. Coal was chosen as the fossil fuel of choice because of its abundance domestically and regionally, and because it was cheaper than other fossil fuels. The Philippine is already dependent on imported coal for its installed generation capacity. The coal price jump in 2008 has shattered this prospect by increasing the cost of imported coal, and puts some pressure on the Philippines to look for large-scale electricity production elsewhere. Indigenous natural gas and coal production have increased to improve the level of self-sufficiency to just over 50%, but this effort did not significantly alleviate Philippine reliance on imported coal and gas because consumption also went up. The rising demand for coal has increased the overall import dependence in total amount.¹⁰³

Other sources of electricity available to the Philippines are geothermal power and hydropower. The Philippines has extensive geothermal resources that could potentially make the Philippines the world's largest producer and user of geothermal energy. Increasing electricity consumption is stressing the country's present sources of electric power, forcing the Manila to consider expansion into alternatives like geothermal. In 2007, the installed geothermal capacity was 2,027.07 MW. An increase of about 820

¹⁰¹ Prime Minister Yab Dato' Seri Abdullah Ahmed Badawi, "Building a Civilisation to Elevate the Nation's Dignity," Motion on Ninth Malaysia Plan 2006–2010, *the Star Online*, 31 March 2006, <http://thestar.com.my/news/story.asp?file=/2006/3/31/nation/20060331170915&sec=nation> (accessed 12 March 2009).

¹⁰² Gunn, "Southeast Asia's Looming Nuclear Power Industry."

¹⁰³ APEC, *APEC Energy Demand and Supply Outlook 2006: Philippines*, 74–78.

MW is expected by 2014. Although these generation capacities seem large, it is equivalent to about one nuclear power plant. It has a little more installed hydropower capacity at 3,257 MW.¹⁰⁴ These numbers are still small when compared to the 15.5 GW of installed generation capacity.¹⁰⁵ The Government of the Philippines is also pursuing policies promoting exploration, conservation, efficiency improvements and electricity sector reforms. These efforts will only reduce the gap between supply and demand, but will not close it.

Although the Philippines has available alternatives for electricity production, its consumption growth is quickly catching up to its generation capacity, especially on Mindanao. Additional generation capacity is needed and it is expected to be in the form of coal power. The Exploration for new sources of indigenous coal and natural gas will help improve Philippine energy self-sufficiency. The levels of success of this effort will play a big role in closing the energy supply and demand gap.¹⁰⁶ Current plans to expand geothermal energy also offer some relief to the energy pressures. The current available alternatives can sustain the Philippines at its present development and consumption rate. So long as the Philippines can maintain their coal and gas production to keep up with demand as they have been, the chance that it will look back to nuclear power for electricity will be small.

D. POLITICAL WILL

The level of political will for developing nuclear energy varies a great deal for the three countries in this chapter, with Burma and the Philippines at the opposite ends of the spectrum and Malaysia in the middle. One reason for this variation is the level of

¹⁰⁴ APEC, *APEC Energy Demand and Supply Outlook 2006: Philippines*, 74–78.

¹⁰⁵ Department of Energy (DOE), “Country Analysis Brief: The Philippines,” *Energy Information Administration (EIA) of the United States Government*, August 2008, <http://www.eia.doe.gov/emeu/cabs/> (accessed 21 April 2009).

¹⁰⁶ Medium–Term Philippine Development Plan 2004–2010, Chapter 11: Power Sector Reform, Philippines National Economic and Development Authority, 2004, 130, <http://www.neda.gov.ph/ads/mtpdp/MTPDP2004-2010/PDF/MTPDP2004-2010.html> (accessed 29 April 2009); Asia–Pacific Economic Cooperation (APEC), *APEC Energy Overview 2007: Philippines*, Asia Pacific Energy Research Center (Tokyo, 2007), 122–130, <http://www.ieej.or.jp/aperc/2007pdf/Overview2007.pdf> (accessed 4 February 2009).

democracy and level of benevolence a particular government has towards its people. An authoritarian government will have an easier time making the national decision to pursue nuclear energy and directing its national effort toward developing nuclear power, because it tends to ignore the needs and political voice of its people and it can brutally suppress the opposition. In the previous chapter, each country assessed had benevolent governments that took the welfare and views of their people into consideration when making policy. This chapter assesses possibly the only country in the region with a government so detached from its populace as to completely disregard their wellbeing. Of course the country in question is Burma. For Burma, political will for nuclear technology development is a factor independent of need as defined by electricity demand or available alternatives.

A more open or liberal state may have to contend with domestic opinion on nuclear power. For Malaysia and the Philippines, mustering the political will to pursue nuclear energy requires more of the people's consent and may be more difficult because of other indigenous conditions. In the case of Malaysia, political will is driven by need as defined by electricity demand and the availability of alternatives. However, to improve the chance of successfully mustering political will behind nuclear energy, Malaysia is approaching this decision very deliberately and cautiously. The Philippines has some experience with nuclear energy in the past, and this experience has left a bitter political after-taste for such a program. The ability to muster political will for nuclear energy in the Philippines faces a large domestic opposition. Political will seems to be a very significant factor contributing to the nuclear energy decision of the three countries in this chapter. The domestic environment for each of these countries must be examined to determine if they can muster political will behind nuclear energy.

1. Burma

Power and control appears to be the driver for the Junta's actions. Any decision it has made concerning economics and trade has lined the pockets of its elites and/or has been mismanaged to the point of minimal benefits for its people. Similarly, its energy policies strengthen the Junta's power base at the expense of its people. Can Burma

muster sufficient political will to pursue nuclear energy? If Burma has proven anything, it is that it has more political will than judgment. This authoritarian regime has extracted labor and resources from its people in support of numerous state objectives without consideration for the human cost. Burma has a relatively robust electricity production capacity compared to its consumption rate. This gap is self imposed. It rations electricity to its public, but can sell it across the border to its neighbors. For Burma, mustering political will is only a matter of getting the elite power-holders to agree, and they have been in agreement on nuclear development since 2001 when the Ministry of Science and Technology, under U Thaung, expressed interest in a research reactor. The development of a 10 MW research reactor in central Burma is already underway with the help of Russia's atomic energy agency, Rosatom.¹⁰⁷

The factors of electricity demand and availability of alternative energy resource do not justify a decision in favor of nuclear energy. The political will to pursue a nuclear program originates from the core of Junta decision makers and the ultimate intent behind this development is unclear. Burma has a long standing history of opposing nuclear weapons and a history almost as long of pursuing peaceful applications of nuclear technology.¹⁰⁸ Reviving the pursuit of nuclear technology may be a matter of national pride or "face" for Burma. Many of its neighbors have research reactors, and Burma might see a research reactor as a step towards becoming a modern nation like its peers. Burma is heavily involved in the energy export business for revenue generation. Nuclear energy may be a source of future electricity exports for when its natural gas reserves run out. Burma has a smaller estimated gas reserves than neighboring Malaysia, which is expected to deplete its reserves by 2038. Malaysia extracts five times more natural gas, but also has a reserve that is greater than five times that of Burma's.

¹⁰⁷ Gunn, "Southeast Asia's Looming Nuclear Power Industry;" Lintner, "Burma's Nuclear Temptation."

¹⁰⁸ Aung Zaw, "Burma Plays Nuclear Card," *The Irrawaddy*, 15.7, June 2007, www.irrawaddy.org (accessed December 30, 2008); Andrew Selth, "Burma and Nuclear Proliferation: Policies and Perceptions," *Griffith Asia Institute*, Regional Outlook Paper No. 12, 2007, 6–10, National Library of Australia <http://catalogue.nla.gov.au/Record/4189828?&#details> (accessed December 28, 2009).

Even if these are the real reasons behind Burma's nuclear aspirations, as usual, the Junta is in keeping with its track record of making things worse (or appear worse) than they already are. The inconsistency between Burma's energy needs and its desire for nuclear technology has many experts worried. Is it possible that Burma has departed from its traditional posture on non-proliferation and is planning to develop nuclear weapons? Is it borrowing a page from the North Korean playbook on blackmail-diplomacy? The fact that Burma is developing a nuclear program with unclear intentions is strategically destabilizing for the region, but Andrew Selth warns of alarmist inflation of Burma's potential of becoming a rogue state armed with nuclear weapons. Selth based his conclusion on several pieces of evidence. First, the majority of alarmist writings originate from Burmese exiles or those who may have an alternative agenda in painting Burma in worse light than it really is. Second, Burma is willing to cooperate with the IAEA in its nuclear program and willing to comply with all protocols. It was the IAEA that turned away from Burma's nuclear program. Finally, it is a long way from a research reactor to weaponization. A research reactor has numerous other peaceful applications.¹⁰⁹ As the situation exists today, it is unclear what is truly driving Burma's political will for nuclear development, but the fact that Burma is proceeding down this path requires close attention without alarmist overreaction.

2. Malaysia

Evaluate Malaysia's electricity demand against its available alternatives and it becomes clear that it needs to seriously look at nuclear energy for large scale electricity generation in the near future. When it comes to political will, Malaysia has demonstrated that it can make decisions and drive the country down the subsequent path of that decision. An exemplary example of this political will is Malaysia's response to the 1997 Asian financial crisis (AFC) in which Malaysia implemented policies opposite to those recommended by the IMF in spite of international skepticism.¹¹⁰ This decision by Malaysian Prime Minister Mahathir appeared risky, but Malaysia mustered the necessary

¹⁰⁹ Selth; Lintner.

political will to implement it, and it paid off. Malaysia's economy reformed and recovered. This recovery has increased the wealth of Malaysia steadily over the past decade. Malaysia has the ability to muster political will in spades, but can it do so for nuclear energy?

In 2006, Deputy Prime Minister Razak outlined Malaysia's position that it would evaluate the applicability of nuclear energy for future use and that it had at least 15 years to do so. This assessment was probably based on the estimates that natural gas reserves would last until about 2038 at the expected consumption rate, and that modern nuclear power plants can be constructed more rapidly today. Malaysia was looking to coal to be the major electricity producer by that time if alternatives are pursued. In the same year, Malaysia restructured the Malaysian Institute for Nuclear Technology Research (MINT) to facilitate the development of a Malaysian nuclear industry and rebranded it as "Nuclear Malaysia," the Malaysia Nuclear Agency.¹¹¹ A one MW research reactor at Bangi in Selangor was in the works.¹¹² Even with all this effort in the direction of nuclear energy, Malaysia continued to refuse accepting nuclear energy as an option for electricity production and only admitted to an emerging interest in it. This was the official Malaysian position as late as mid-2008.¹¹³ It seems that by the end of 2008, the timetable for this effort had shifted to the left. In response to a jump in coal prices in June 2008, the Energy, Water and Communications Minister (Datuk Shaziman Abu Mansor) made a statement in September 2008 that Malaysia will have to resort to nuclear energy for electricity as early as 2023.¹¹⁴ The nuclear energy issue in Malaysia is moving quickly and the domestic debate has not fully matured. These changes in Malaysian policy indicate that it is building political will behind nuclear energy, and that it is only a matter of time before it decides to officially pursue nuclear energy.

¹¹⁰ Richard Stubbs, "Liberalization, Economic Crisis and Regionalism," in *Rethinking Asia's Economic Miracle* (New York: Palgrave Macmillan, 2005), 204–205.

¹¹¹ Malaysia Ministry of Science, Technology and Innovation (MOSTI), *Malaysian Nuclear Agency 2006 Annual Report*, May 2007, 8, http://www.nuclearmalaysia.gov.my/index.php?option=com_content&task=blogcategory&id=111&Itemid=105 (accessed January 16, 2009).

¹¹² Gunn, "Southeast Asia's Looming Nuclear Power Industry."

¹¹³ Nuclear Malaysia Database.

¹¹⁴ Singh.

3. Philippines

Gaining necessary political will to support nuclear energy in the Philippines poses a different problem from all the other countries within the region. The Philippines has already committed to nuclear energy once before only to be burned by corruption and ineptitude. The Philippines spent nearly \$2 billion on the BNPP contracted during the Marcos regime. This plant has never been activated and has produced zero kilowatts of electricity since its construction. Allegations of corruption and insufficient workmanship have brought into question the functionality of the facility. A 1986 international inspection of the plant deemed it unsafe to operate because of proximity to a fault line and volcano not because of corner-cutting or insufficient workmanship. The Philippines government has only finished paying off the construction cost to Westinghouse in 2008.

The Aquino government institutionalized constitutional measures against ever using nuclear energy because of this bad experience.¹¹⁵ Overturning these measures would be the first step in mustering *political will* in support of nuclear energy today. Since the Aquino administration, the Ramos, Estrada and Arroyo administrations have each looked into reviving the nuclear program at the start of their respective administrations to ease energy pressures. Each conducted inspections and assessments of the old Bataan plant, but the resulting debate as to the feasibility of bringing this plant to operating condition were always inconclusive. All three administrations have been unsuccessful in mustering the necessary political will to adopt nuclear energy thus far.¹¹⁶ A paradox in policy in the Aquino administration was the transformation of the Philippines Atomic Energy Commission (PAEC) into the Philippines Nuclear Research Institute (PNRI). The PNRI was responsible for the advancement and regulation of the peaceful application of nuclear science and technology in the Philippines to include nuclear energy.¹¹⁷ This agency objective clear indicates that Manila did not want to completely close the door on nuclear energy even with overwhelming public pressure to

¹¹⁵ Gunn, "Southeast Asia's Looming Nuclear Power Industry."

¹¹⁶ Gunn; Quilop.

¹¹⁷ Quilop; Philippines Nuclear Research Institute (PNRI) Database, About PNRI, Functions, <http://www.pnri.dost.gov.ph/> (accessed April 1, 2009).

do so. If nuclear energy is to be forever banned from use, why have promotion of nuclear energy as an objective in PNRI? Following the patterns of subsequent Philippines presidents, it can be concluded that the action to constitutionally limit the use of nuclear energy was the desire of the people while the political leadership dealing directly with the global energy pressures cling to nuclear energy as a possible option. The sole obstacle to political will behind nuclear power is the acceptance of the Philippines public.

As global energy pressures makes electricity more and more expensive, the price tag for refurbishing this facility may appear less daunting and more agreeable. The historical experience of this “White Elephant” has built a tremendous obstacle to obtaining political will in favor of nuclear energy and the only way this obstacle can be overcome is if it becomes cheaper to pursue this option than to continue to buy energy on the global market. At present, this is not the case, so the Philippines will continue to have insufficient political will for nuclear energy, but this basic supply and demand relationship will eventually catch up.

E. ADEQUATE MEANS OF PRODUCTION TO DEVELOP NUCLEAR POWER

To pursue nuclear power a country must have a lot of capital and skilled labor. In these Southeast Asia countries, capital and labor are not the big obstacle to nuclear energy development as one may expect. All three countries in this chapter have or can acquire very quickly the adequate capital and skilled labor necessary for developing a nuclear program. The more means of production a country has, the more likely it will explore nuclear energy as a solution to its energy pressures.

1. Burma

Although Burma’s populace is one of the poorest in Southeast Asia, the Junta has large amounts of capital from its resource extraction industry. Burma exports an abundance of oil and natural gas to its neighbor Thailand and other Asian countries. Revenues from these transactions account for over half of Burma’s export value. Burma also has a strong agricultural and mineral base that accounts for over 50% of its GDP and

43% of its export.¹¹⁸ The profits resulted from the exploitation of these resources goes into the regime coffer and not back out to its people, retaining a great deal of wealth for the Burmese elite. As discussed in the political will section, the Junta has the authority to use this large amount of capital in any way they want with little to no opposition.

Evidence of Burma's ability to compile necessary funding for this project occurred between 2002 and 2005. In late 2002, the research reactor project with Russia stalled over disagreement on the amount of advance payment. Rangoon wanted to pay only 10% as an advance, while the Moscow wanted a 25% advance payment. The project resumed in 2005 when Rangoon appeared to have mustered sufficient funds.¹¹⁹ The Junta has Burma's resource wealth at its disposal without account, and can pour as much capital into this effort as it likes

One would expect that Burma does not have a good indigenous pool of skilled labor necessary for developing a nuclear power program. Its economy is based mainly on resource extraction, with little heavy industry and practically no value-added industry. This assessment of Burma's skilled labor pool may be inaccurate. Burma has completed numerous hydropower projects and has many more underway.¹²⁰ They have been receiving technical assistance in these projects from China. Although the skill sets for building a dam is not directly transferable to the skill sets for building a nuclear power plant, it does demonstrate that Burma has a workforce that is capable of accomplishing large technical construction projects involving energy production. With outside assistance, mainly from the Russians, it is possible that Burma can develop a sufficient skilled-labor pool to assemble a Russian research reactor.

2. Malaysia

Malaysia is a newly industrialized country with a growing economy. It is moving its economy up to "value-added" goods level in the industrial production chain. Some

¹¹⁸ U. S. Department of State Databases, <http://www.state.gov/r/pa/ei/bgn/35910.htm> (object name Background Note: Burma; accessed March 13, 2009).

¹¹⁹ Selth, 7.

¹²⁰ Selth, 6–8; Burma River Network database.

examples of the value-added fields in which Malaysia is branching out are high-tech electronics industries, medical technologies and pharmaceuticals. As a lesson learned from the 1997 Asian Financial Crisis, Malaysia had insulated itself from external economic crisis with large foreign exchange reserves and small external debt.¹²¹ This foresight may alleviate some of the impact of the 2009 global recession on the Malaysian economy. All this indicates that Malaysia should have the ability to amass sufficient capital to support a nuclear power program when it decides to officially pursue one.

Malaysia's progression up the industrial production chain also means that its workforce is becoming better trained and more skilled. The skill sets at this higher level of industrialization is more applicable to nuclear power than skill sets from lower levels of industrialization such as resource extraction. Malaysia's advancement in technology and industry has built a skilled labor pool conducive to pursuing nuclear power, if it chooses to do so.

3. Philippines

The Philippines has recently completed payment to Westinghouse for a nuclear power plant, proving that it can overcome the sufficient capital hurdle. It took a little less than 32 years. Ironically, this nuclear power plant has not produced any electricity, and evaluations on whether or not it is safe to operate are inconclusive.¹²² The Philippine GDP is growing in similar trends to the rest of Southeast Asia at 7% in 2007 and 4.5% in 2008. Its strong GDP performance is due to high government spending, a strong service sector and large amounts of remittances from millions of Filipinos working abroad.¹²³ The Philippines past record and present performance indicates that it would be able to amass sufficient capital to restart its nuclear energy program if it so chooses. But having already paid the bill for one nuclear power plant with no returns, it is very unlikely that

¹²¹ Central Intelligence Agency, *The World Factbook: Malaysia*.

¹²² Addison; Quilop.

¹²³ Central Intelligence Agency, *The World Factbook: Philippines*.

the Manila will fund another. Instead, opportunity costs may make it wiser to refurbish the existing plant for energy production whether by nuclear or by some other source of energy.

By nuclear industry standards, inconclusive evaluations on whether or not a plant is safe to operate amounts to a negative determination because severe potential consequences require decision makers to err on the side of caution. The main issue of concern with the BNPP is whether sufficiently skilled labor was used during the plant's construction. When the plant was contracted during the Marcos regime, suspicions of corruption and nepotism suggest that although skilled labor was available, cheaper unskilled laborers were used in order to skim money into the pockets of the project heads.¹²⁴ Does the Philippines have a sufficiently skilled labor pool to pursue a nuclear program today? The Philippines is an industrialized country with a mixed range of industries from pharmaceutical and high-skill industries to low-skill manufacturing and agricultural industries.¹²⁵ Based on this wide range of skill in the labor pool, the Philippines should have sufficient skilled labor base to support a nuclear energy program again, if it ever overcomes its painful experience with nuclear energy.

F. TECHNICAL CAPACITY

Developing a nuclear energy program requires human capital investments in more than skilled labor. The technical capacity aspect of nuclear power deals with the knowledge, proficiency and training of the operators and administrators of such a program. Acquiring and maintaining these skills in Burma, Malaysia and the Philippines require significant human capital investments on the part of the state and its education system. Scientists, engineers and administrative bureaucrats must be trained to the internationally accepted standards of the IAEA. Quality control is an issue in which these countries are notoriously weak. The BNPP demonstrates this point in the Philippines. Nuclear reactors components must be constructed and assembled to withstand the torturous operating conditions of nuclear energy and the potentially

¹²⁴ Addison; Quilop.

¹²⁵ Central Intelligence Agency, *The World Factbook: Philippines*.

inhospitable environment present in Southeast Asia. A quality-control regime independent of the labor force is essential in starting a nuclear project and in keeping it running for years to come. A country is more likely to pursue nuclear energy when it has higher levels of technical capacity. A country can acquire this technical capacity through training and educational programs with the IAEA or other technology holders, but a base foundation in engineering and the sciences from an indigenous education system must be present.

1. Burma

Burma currently lacks the technical capacity to pursue a nuclear program. The IAEA feasibility inspection conducted in 2001 upon Burma's expressed interest in a research reactor indicated that Burma had a poor technological base and a collapsed education system. It has insufficient technical capacity, and presently lacks the means to indigenously develop one. To compound this issue, the IAEA has ignored any Burmese request for assistance in pursuing a research reactor based on these finding and other political reasons involving human right.¹²⁶

Burma's lack of technical capacity and the avenue for acquiring it is being remedied by the wealth of the Burmese elite and assistance from Russia. Many Burmese scientists and engineers are educated outside of Burma in western countries, mitigating the problem of its collapsed education system. This means that Burmese scientists and engineers for the most part come from the Burmese elite who have enough money to send them to school. As part of the deal with Moscow, 300 to 350 Burmese specialists are to be trained by Russia to operate the research reactor. Numerous reports of large numbers of Burmese receiving nuclear training in Russia surfaced in 2002 and 2003. It is not unexpected that a Russian-Burma deal of this magnitude would include nuclear training for Burmese scientists and technicians. Lintner claims that 350 Burmese nationals (mostly military) had undergone nuclear training in Russia as part of the initial deal with Rosatom and several hundreds more have since been trained by the Russians.¹²⁷ With

¹²⁶ Selth, 6.

¹²⁷ Selth, 9; Gunn; Lintner.

the assistance of Russia, Burma is rapidly developing the technical capacity necessary to at least start a nuclear research program. It does not yet possess sufficient levels of technical capacity to handle such a program without heavy assistance from the outside. Until Burma establishes an effective education system to transfer knowledge gained from Russia and the West to follow-on generations, it will not be able to sustain the technical capacity necessary to maintain a nuclear program without outside assistance.

2. Malaysia

Malaysia's progression up the industrial production chain along with the work done by Nuclear Malaysia (Malaysia's nuclear agency) in coordinating training with the IAEA has put Malaysia in a good position to quickly develop the necessary level of technical capacity to support a nuclear energy program. Malaysia is branching out into the value-added and high tech industries.

Malaysia has a Ministry of Science, Technology and Innovation (MOSTI), which has taken the lead on enhancing science, technology and innovation (STI) for the purposes of supporting economic growth. The technical nature of Malaysia's growing industries needs scientists, engineers and technical administrators to function. A secondary objective of MOSTI is to cultivate technical capacity for nuclear energy in Malaysia. It has reorganized a sub-agency responsible for nuclear technology research and now calls it Nuclear Malaysia. The objective of Nuclear Malaysia is to promote nuclear technology for industry and for energy production.¹²⁸ It is from the pool of scientists, engineers, and technical administrators developed by MOSTI and Nuclear Malaysia for Malaysian industry that a nuclear energy program will draw its talent. As more scientists, engineers and technical administrators are produced for the job market, more will also be available for the nuclear energy field as well. Nuclear Malaysia is also conducting training courses and workshops for its personnel on numerous technical subjects necessary for a nuclear energy program as indicated in its 2006 annual report.¹²⁹ It is logical to speculate that this training program continued to the present.

¹²⁸ MOSTI, *Malaysian Nuclear Agency 2006 Annual Report*, 3–12.

¹²⁹ *Ibid.*, 13–22.

Malaysia has sought IAEA technical assistance in building its *technical capacity* for nuclear energy. Malaysia has completed or is involved in 94 Technical Cooperation (TC) projects with the IAEA. Forty-two of the 94 projects are applicable to nuclear energy. Of the eight TC projects active today, five projects are directly applicable to nuclear energy development. In Southeast Asia, only Indonesia, the Philippines and Thailand have more TC projects with the IAEA.¹³⁰ Malaysia may have sufficient *technical capacity* for a nuclear energy program or is very close to developing it indigenously. Since it has less urgency for developing nuclear energy because of its policies on fuel conservation and its reserves, it has the luxury of time to develop this capacity in a sustainable manner and to court public opinion in favor of it.

3. Philippines

The Philippines has been involved in the nuclear energy game since the 1970s. As previously discussed, PNRI has roots going back to the PAEC started in 1958 in concert with the U.S. Atoms for Peace program. The mission of PNRI is to promote and regulate the peaceful application of nuclear science and technology. For the most part, PNRI has been doing just that. The PNRI has been working with agriculture and industry to improve production with the assistance of nuclear science and technology. The PNRI has also coordinated education opportunities to a wide audience, ranging from industry to high school and college students.¹³¹ The PNRI has been promoting the safe and peaceful application of nuclear technology effectively in the Philippines and proven that it is a competent technical organization. If the Philippines were to pursue nuclear energy, it is likely that PNRI will lead the way.

The Philippines has also participated in the IAEA TC program. In Southeast Asia the Philippines is second only to Indonesia in the number of IAEA TC projects active or completed. It also has the second largest number of TC projects applicable to nuclear energy development active or completed in the region. Close coordination with the

¹³⁰ International Atomic Energy Agency (IAEA) database, <http://www-TC.project.iaea.org/TC/projectweb/default.asp> (object name Department of Technical Cooperation; accessed July 25, 2008).

¹³¹ Philippines Nuclear Research Institute, *PNRI Annual Report 2007*, 2007, 3–23, <http://www.pnri.dost.gov.ph/pnri.php?pnri=publications> (accessed April 1, 2009).

IAEA in assessment of the BNPP has also built experience in the Philippines technical community in working with nuclear energy issues. The focus of the majority of TC projects conducted have been relate to the BNPP issue in some way or another.¹³² Although, the PNRI has not focused on nuclear energy development in its projects with the IAEA TC program, it did build human capital in related fields. Under this circumstance, the Philippines does not have sufficient technical capacity for nuclear energy development, but it can rapidly transition its present technical capabilities in that direction if nuclear energy becomes publically acceptable.

G. INTERNATIONAL SUPPORT

Unlike in the countries discussed in Chapter II that had decided against pursuing nuclear energy, international support played a significant role in the nuclear decision for the countries in this chapter. Support provided by the international community (as represented by the IAEA) and/or technology holders is a fundamental ingredient to developing a nuclear energy program in Burma, Malaysia and the Philippines. Technology holders include the United States, China, Japan, South Korea, France and Russia. For the IAEA, the determinant of whether international support is provided hinges on three issues. These three issues are nuclear weapon proliferation, the electricity needs of the country and nuclear safety and security. These three issues directly or indirectly impact regional stability.

For technology holders, the decision to provide assistance hinges on their national interests. If the national objective is regional stability, technology holders may fall back on proliferation, electricity needs and nuclear safety and security as reasons to provide or withhold assistance. On the other hand, individual national interest of a technology holder may motivate it to provide assistance to one of these countries regardless of international community approval. The latter is the case with Burma. The countries in this chapter can be split into two categories when it comes to international support. The first is Burma where the international community as represented by the IAEA is very reluctant to assist in its nuclear research program, and a technology holder (Russia) is

¹³² IAEA database, Department of Technical Cooperation.

providing assistance because it is in its national interest to do so. The second category includes Malaysia and the Philippines. These countries have not committed to nuclear energy development at present, but international support is readily available or has been provided in the past.

1. Burma

Burma has developed a poor reputation with the international community over the years. When Burma attempted to gain IAEA support for a research reactor in 2001, it was met with skepticism and contempt. Next, Burma turned to Russia, one of its largest trading partners, who agreed to assist Burma with its aspirations for a research reactor. Together both sides came to a deal that Russia would provide a research reactor and nuclear training for Burmese scientist and specialists in exchange for payment in money and primary goods.¹³³ Through this deal, Burma received technology and material support for its nuclear research program.

Why is Russia helping Burma with a research reactor? Russian national interests in Southeast Asia include access to resources and markets, and increase in Russian influence in regional affairs. These interests are best served by this course of action. Burma is rich in natural resources. Russia is already a large trading partner with Burma, because it is one of the few countries that will trade with it. By entering this agreement, Russia increases its influence over Burma and gaining a level of dependence from it. Burma is a member of ASEAN and this may be Russia's way of worming its influence into the Southeast Asian region, an area where Russian influence has been waning since the collapse of the Soviet Union, the rise of China and liberal market reforms. Burma also sits along the shipping lanes between Europe and Asia. To have a Russian friendly port along this trade route would benefit Russian national interest. Again increasing Russian influence in Burma helps solidify this interest.

Can Burma earn the approval of the international community for its research reactor? Burma does not need nuclear energy as determined by the sections on electricity

¹³³ Selth, 6.

demand and available alternatives. The international community also doubts that Burma can safely run such a program based on its technical capability shortfalls in the area of sustainment. At the heart of this question is the issue of whether Burma is doing this for peaceful applications or does it have intentions to weaponize this technology. Burma has been a long-standing proponent of non-proliferation and nuclear disarmament. Through its work in non-proliferation and disarmament, Burma has achieved significant international recognition in spite of its poor economic and human rights record, and was selected the Chairman of the UN First Committee in 2000. Burma is a party to the Nuclear Non-Proliferation Treaty (NPT) and the additional protocols of the IAEA. It is also a signature to the Bangkok Treaty establishing a Southeast Asia Nuclear Weapons-Free Zone. Burma has signed the Comprehensive Nuclear-Test Ban Treaty (CTBT) but has not ratified it.¹³⁴ But the authoritarian and opaque nature of this regime leads many to believe that Burma can abandon its traditional position on non-proliferation for what it perceives to be a security issue. Burma's growing isolation and ties to North Korea also casts doubt on Burma's intentions of non-proliferation.¹³⁵ As discussed in the political will section, the driver for Burma's desire for a research reactor is unclear. What is certain is that Burma's interest in nuclear energy has drawn the attention and concern of many in the international community.

Burma has a relatively strong level of support from Russia in the area of technology and materials. It lacks international approval, mainly because of the lack in transparency behind its desire for nuclear technology. This lack of transparency is made worse by the repressive and reclusive nature of its ruling regime and the relatively underdeveloped condition of the country as a whole.

¹³⁴ United Nations(UN), "Status of Multilateral Arms Regulation and Disarmament Agreements," United Nations Office of Disarmament Affairs (UNODA), <http://disarmament.un.org/TreatyStatus.nsf> (accessed April 3, 2009); International Atomic Energy Agency, *Nuclear Safeguards and Verification*, http://www.iaea.org/OurWork/SV/Safeguards/sg_protocol.html (accessed April 3, 2009); Association of Southeast Asian Nations, *Treaty on the Southeast Asia Nuclear Weapon-Free Zone Bangkok, Thailand*, 1995, <http://www.aseansec.org/2082.htm> (accessed April 2, 2009); Comprehensive Nuclear-Test Ban Treaty Organization, Member States, Status of Signature and Ratification database, http://www.ctbto.org/member-states/?no_cache=1 (accessed April 1, 2009).

¹³⁵ Michael S. Malley, "Prospects for Nuclear Proliferation in Southeast Asia, 2006 – 2016," *NonProliferation Review* 13, no. 3 (2006), 607–610; Selth, 3, 11–22.

2. Malaysia and The Philippines

These two countries have not committed to nuclear energy, yet international support for such an effort is readily available to them. Both countries had demonstrated a need, albeit not an urgent need, for a large-scale source of electricity such as nuclear energy. Both had a long history of credible levels of commitment to non-proliferation. Both are parties to the NPT, the IAEA Additional Protocols, the CTBT and the Bangkok Treaty.¹³⁶ Although both countries have potential security issues with nuclear-capable China over the Spratly Islands, the threat perception between them is low and not substantial enough to cause either Malaysia or the Philippines to consider developing nuclear weapon. China realizes that it has more to lose by taking a confrontational posture with other Spratly claimants and has shifted to softer influences. China has been pushing for bilateral cooperation with other Spratly claimants and has achieved some level of energy cooperation with the Philippines.¹³⁷

Even though not perfect democracies, both Malaysia and the Philippines are considered to be well-established democracies in Southeast Asia. Both have mature indigenous educational systems that support technological industries and demonstrate a certain level of technical capacity on which nuclear technology can build. All these things contribute to gaining a sense of feasibility in the eyes of the international community for these two countries, and access to international support and assistance is readily available.

Other sources of technical and material support available to Malaysia and the Philippines come from Japan and South Korea. Both countries are looking to expand their respective nuclear industry beyond domestic markets. Both Japan and South Korea realized that their domestic consumption of the nuclear industry is not sufficiently to sustain this industry without export.¹³⁸ Toshiba of Japan now owns Westinghouse

¹³⁶ UN, "Status of Multilateral Arms Regulation and Disarmament Agreements," IAEA, "Safeguards and Verification," ASEAN, *Treaty on the Southeast Asia Nuclear Weapon-Free Zone*; CTBTO.

¹³⁷ Leszek Buszynski and Iskandar Sazlan, "Maritime Claims and Energy Cooperation in the South China Sea," *Contemporary Southeast Asia* 29, no. 1 (2007), 156–168, Project Muse <http://muse.jhu.edu/journals/> (accessed April 3, 2008).

¹³⁸ Gunn, "Southeast Asia's Looming Nuclear Power Industry."

Electric Company LLC, the company that was contracted to build the BNPP in the Philippines as well as numerous nuclear power plants in the United States.¹³⁹ Both may look to Malaysia and the Philippines as a future market. Since both countries have a high level of international legitimacy for pursuing nuclear energy, they make ideal customers unlike Burma.

Until recently, Malaysia has not seriously reached out to anyone for assistance in nuclear energy development. Ironically, in 2007 the Director General of the IAEA, Dr. Mohamed ElBaradei, had offered Malaysia assistance in nuclear energy development as a means to relieve Malaysia's near term energy pressures.¹⁴⁰ In October 2008, Malaysia's representative to the 52nd General Conference of the IAEA expressed Malaysia's desire to include nuclear power development in future TC projects in order to prepare for a possible implementation of a nuclear power program.¹⁴¹

During the 1970s and 1980s, the Philippines had received full U.S. assistance through the Westinghouse Corporation for its nuclear energy program. If the Philippines were to reverse its position on the use of nuclear energy, assistance from the United States may be just as forthcoming. The Philippines is a U.S. treaty ally. This current relationship is focused on balancing against Chinese influence in the region, and fighting terrorism and insurgency in the Southern Philippines. This commitment makes stability and growth in the Philippines a U.S. concern. This makes the United States again a possible source of technology and materials to a Filipino nuclear power program.

¹³⁹ "Toshiba Completes Westinghouse Acquisition." Westinghouse press release, October 2004. http://www.prnewswire.com/cgi-bin/micro_stories.pl?ACCT=no&TICK=WE&STORY=/www/story/10-17-2006/0004453746&EDATE (accesses April 22, 2009).

¹⁴⁰ Mohamed ElBaradei, IAEA Director General, "Nuclear Power: Looking to the Future," *Statement of the Director General at Nobel Laureate Public Lecture*, Kuala Lumpur, July 2007, <http://www.iaea.org/NewsCenter/Statements/2007/ebsp2007n011.html> (accessed April 3, 2009).

¹⁴¹ Daud Mohamad, "Statement by Dr. Daud Mohamad, Director General, Malaysian Nuclear Agency, Head of Delegation of Malaysia to the 52nd Regular Session of the General Conference of the International Atomic Energy Agency (IAEA)," Vienna, October 2008, 3.

H. CONCLUSION: EACH COUNTRY'S DECISION

The countries in this chapter fall into a category between those that have abstained from nuclear energy use and those that are actively pursuing it. This in-between status is a catch-all; countries fall into this category for different reasons. Burma is looking to acquire nuclear technology by way of a research reactor project with assistance from Russia. Malaysia is coming to terms with the realities of its energy pressures and is making a national course-steer towards nuclear energy. The Philippines is recovering from a bad experience with nuclear energy and remains reluctant to reconsider this fuel source to relieve its growing energy pressures. Each country in this chapter faces a unique situation.

1. Burma

The driver for Burma's pursuit of nuclear technology is not a need for power generation. In any case, it is not certain what objective has solidified Burma's political will behind a nuclear research program. Speculations on this objective range from national prestige to the possibility of weaponization. The extreme alarmist views are unsubstantiated by Burma's past actions and continued membership in numerous nonproliferation entities. With its newfound boon in energy export, it is possible that Burma's true objective lies in the middle of the extremes in that it is looking to supplement its energy export industry with electricity generated from nuclear power. The only thing that is clear is that political will and international support are the dominant factors in Burma's decision to pursue nuclear energy. Without the assistance it is receiving from Russia, Burma would have no way of establishing a nuclear research program. Moscow's assistance is at least more transparent than other potential technology holders such as North Korea, Iran and possibly the Khan network, and can stand up to IAEA scrutiny.

2. Malaysia

The Malaysian case is relatively easy to understand. Malaysia has a growing need for electricity and this need is motivating the political will to explore nuclear energy. The

interesting point about Malaysia is how that political will is directing the course of nuclear energy development. Malaysia's growing electricity demand and shrinking natural gas reserves combine to produce a relatively gradual timeline for Malaysia to develop nuclear energy. The political will for Malaysia's nuclear energy program resides in the government, who has contained the debate by not officially committing to nuclear energy use and only expressed an "emerging interest." At the same time it is using MOSTI and Nuclear Malaysia to develop the support base for nuclear energy by promoting nuclear technology and education and training. One day the people of Malaysia are going to wake up to the condition where the need for a new large scale energy source is great and groundwork for a nuclear power program is mature. It will seem like a natural fit and Malaysia will officially adopt nuclear energy development. This makes political will the dominant factor in the Malaysian case with electricity demand and available alternatives as significant supporting factors.

3. Philippines

The weakness of political will is the central factor in the Philippines' decision on nuclear energy. Although the need as a function of electricity demand and available alternatives is present, it is not urgent because of the potential alternatives such as geothermal power and continued exploration of indigenous coal sources. It is also overshadowed by the bad experience of the Bataan Nuclear Power Plant contracted and constructed in the late 1970s and early 1980s. The Philippine public is adamantly against the use of nuclear energy in the country even while facing growing energy pressure, while the political leadership is more pragmatic and has not closed the door on nuclear energy in the Philippines. The Philippines does have an available alternative in geothermal energy but it appears to be only moderately interested in this option.

4. Closing Summary: Countries of Contradictions

Surprisingly, the means of production and technical capacity had relatively little impact because of various domestic factors or a work-around between technology holders and the countries in this chapter. Burma and the Philippines behaved contrary to the

impact of electricity demand and availability of alternatives. Burma had little need for nuclear development opted to pursue a nuclear research program with power generation potential in the future. The Philippines had a greater need for nuclear development but chose to abstain because of a prior bad experience. In Malaysia's case, the combination of electricity demand and available alternatives afforded less it with urgency for nuclear energy development, somewhere in between the Philippines and Burma. Support from the IAEA was denied to the country seeking it and was readily available to the two countries that were less urgent about it or not interested in it at all.

For the countries in this chapter, political will was consistently the dominant factors in their policies regarding nuclear energy. This factor produced decisive effects both for and against nuclear power developments in Burma and the Philippines respectively. In Malaysia, political will shapes the method by which the country will ease into nuclear power development. This process may be critical to its long-term success in Malaysia because it will not be rushed into doing it fast but can take its time and do it right.

	Electricity Demand	Available Alternatives	Political Will	Means of Production	Technical Capacity	International Support
Burma	Small and lacks a robust distribution system	Abundance of natural gas and hydropower	Military Junta desires to gain nuclear technology (reason behind drive is unclear)*	Adequate capital Adequate labor	Inadequate technical capacity	Russia*
Malaysia	Large demand and growing	Natural gas reserves are expected to be depleted by 2038.	Malaysian state recognizes the need for nuclear energy and is progressively promoting it to the public*	Adequate capital Adequate labor	Adequate technical capacity	IAEA has offered assistance. Japanese and South Korean nuclear industry
Philippines	Large demand and growing at a rate that will outpace its available energy sources	Natural gas, coal, oil and geothermal energy.	Bad experience with BNPP and Westinghouse has entrenched domestic pressure against nuclear energy use in the Philippines*	Adequate capital Adequate labor	Adequate technical capacity	Past support from the United States through Westinghouse Corp. Japanese and South Korean nuclear industry

(*) The dominating factor in a country's decision on nuclear energy.

Table 2. Factors in Countries That May Pursue Nuclear Energy

IV. COUNTRIES THAT HAVE ELECTED TO PURSUE NUCLEAR ENERGY

A. INTRODUCTION

Several Southeast Asian countries are looking to develop nuclear power to augment their energy portfolio. The advent of a successful nuclear energy program can provide some relief from the pressures of fossil fuel dependence. Indonesia, Thailand and Vietnam plan to have a functioning nuclear power program by the 2016-2020 timeframe. Indonesia is slower because it is balancing domestic preferences for and against nuclear energy development. However, Indonesia has a significant lead on the other countries with its five decades of sporadic work towards this goal.¹⁴² It plans to build a 2,000 MW nuclear plant by 2017. Earmarks of \$8 billion for the development of four nuclear power plants by 2025 have been planned in Indonesia's budget to increase nuclear energy's share in electricity production by an additional 6,000 MW beyond the initial 2017 numbers.¹⁴³ Thailand is making the slowest progress because of the political turmoil since the 2006 coup. It is planning a 2,000 MW power plant (2 x 1,000 MW reactors) for operation in 2020 and one more 2,000 MW power plant in 2021.¹⁴⁴ With its present political situation, this goal may not be achievable per the timeline prescribed.

Vietnam is the most aggressive pursuer of nuclear energy among the three. The Vietnamese government has laid out an ambitious plan for future development of their electricity production capabilities. Nuclear power, as expected, will be evaluated on a trial basis initially with plans for a 2,000 MW nuclear power plant by 2020. Vietnam has named two sites for their nuclear power plants. The Ninh Thuan nuclear power plant No 1 will be in Phuoc Dinh Commune, Ninh Phuoc District and the Ninh Thuan plant No 2

¹⁴² Gunn; Malley and Ogilvie-White, 3, 9–15.

¹⁴³ Symon, "Southeast Asia's Nuclear Power Thrust," 125–126.

¹⁴⁴ Electricity Generating Authority of Thailand (EGAT), "Thailand Power Development Plan 2007–2021," (System Plan Division, Report number 912000-5104 January 2008), 9, 15, 18, 22, 48; Asia–Pacific Economic Cooperation (APEC), *APEC Energy Overview 2007: Indonesia*, Asia Pacific Energy Research Center (Tokyo, 2007), 73, <http://www.ieej.or.jp/aperc/2007pdf/Overview2007.pdf> (accessed February 4, 2009).

will be in Vinh Hai Commune, Ninh Hai District.¹⁴⁵ An expected increase in nuclear energy generation to 8,000 MW is planned by 2025. With this avenue of energy portfolio diversification, Indonesia, Thailand and Vietnam are taking steps to see if nuclear energy is a long-term, large scale solution for their electricity needs. It is unrealistic to expect that nuclear power will produce a significant share of their generation capacity in the near future. However, this prospect may occur over several decades if nuclear energy proves successful. Indonesia and Vietnam are more confident in the prospects of nuclear energy than Thailand, as indicated by their ambitious plans for four nuclear power plants in comparison to Thailand's two. The development of one or two nuclear power plants with capacities in the few thousand MW is still only a small fraction when the total increase in generation capacity is expected to be in the 100 GW range in the next two decades. If nuclear energy proves to be a successful source of electricity, as it has for countries like France, South Korea, Japan and Taiwan, these Southeast Asian countries may try to make it a significant share of the total electricity generation capacity.

B. ELECTRICITY DEMAND

Electricity demand is inextricably linked to development, and assessing that demand is the first step toward gauging the need for nuclear energy. The demand for electricity in Indonesia and Thailand is similar in the sense that both countries have a large demand driven by development, and that it is expected to grow significantly in the next two decades. Vietnam presents a slightly different electricity demand scenario with a smaller initial demand, but with the potential to grow as large as the other two as a result of more rapid rates of economic growth.

1. Indonesia and Thailand: Two Growing Peas in a Pods

Indonesia and Thailand's electricity demand is driven by their respective economic development. The high level of industry, manufacturing and commerce in these two countries produce large electricity demands. Couple this with the resulting

¹⁴⁵ "Vietnam announces plan to build two nuclear power plants in central province," *BBC Monitoring Asia Pacific*, November 3, 2008, <http://www.nexis.com> (accessed December 5, 2008).

levels of urbanization, increased income and improved standards of living, and it is plain to see why electricity demand in these two countries is so high. In 2005, Indonesia had about 28 GW of installed generation capacity with an annual consumption of about 127,000 GWh.¹⁴⁶ By the end of 2007, Thailand had about 28.5 GW of installed generation capacity with an annual consumption of about 135,000 GWh.¹⁴⁷ By comparison, in 2005, Malaysia had an installed capacity of about 20 GW and consumed 72,700 GWh of electricity, and the Philippines had 15.5 GW of installed capacity and consumed 46,900 GWh. Thus, Indonesia and Thailand consume nearly twice the amount electricity as Malaysia and three times that of the Philippines. This level of consumption is still far below the levels of Japan and South Korea (1 million GWh and 343,000 GWh respectively), but is approaching it.¹⁴⁸ These numbers represent current electricity demand and capacities. In the face of growing demand, it is easy to see Indonesia and Thailand trying to follow suit.

To promote further economic growth, industry and commerce in these two countries must expand. This expansion will result in still greater levels of electricity consumption and increased urbanization. Economic growth and development in these countries over the past decade already has improved living standards, and as a result more people in these countries now own electricity consuming appliances and luxury goods. Because of these trends, the electricity demand in Indonesia is expected to triple in the next two decades with the fastest growth coming from the commercial sector followed by the residential sector. The rate of urbanization is expected to increase from 44% in 2002 to 95% by 2030.¹⁴⁹ Prior to the 2006 coup and 2008 financial recession, Thailand's electricity demand was expected to quadruple in the next two decades, driven

¹⁴⁶ Department of Energy (DOE), "Country Analysis Brief: Indonesia," *Energy Information Administration (EIA) of the United States Government*, January 2007, <http://www.eia.doe.gov/cabs/Indonesia/Electricity.html> (accessed April 2, 2009); APEC, *APEC Energy Overview 2007: Indonesia*, 62.

¹⁴⁷ Thailand Power Development Plan 2007–2021, 2.

¹⁴⁸ Department of Energy (DOE), "Country Analysis Brief," *Energy Information Administration (EIA) of the United States Government*, 2009, <http://www.eia.doe.gov/cabs/index.html> (accessed April 2, 2009)

¹⁴⁹ Asia-Pacific Economic Cooperation (APEC), *APEC Energy Demand and Supply Outlook 2006: Indonesia*, Asia Pacific Energy Research Center (Tokyo, 2006), 33–36, <http://www.ieej.or.jp/aperc/outlook2006.html> (accessed December 23, 2008).

by the manufacturing and service sectors.¹⁵⁰ It is difficult to gauge how much these two events will impact this prediction, but it is reasonable to expect significant growth in electricity demand in Thailand's near future. By expanding their viable large scale electricity production capacities, these countries will have sufficient electricity to power new office buildings, hospitals, public transportation systems, and many other byproducts of urbanization and development. Nuclear energy can be that large scale capacity. The high level of electricity demand and its expected growth makes the pursuit of nuclear energy a promising prospect for Indonesia and Thailand.

2. Vietnam

At present, Vietnam's electricity demand is not extraordinary when compared to other countries in Southeast Asia. It rivals the Philippines with 12 GW of installed production capacity and consumed a little more than 40,000 GWh of electricity in 2004.¹⁵¹ What makes Vietnam special is that its projected electricity demand growth rate is 7.8%, the highest of any countries in the region. Although it is presently a net exporter of energy, Vietnam is expected to become a net importer of energy by 2020. The driver for this trend is Vietnam's rapid industrialization and increased service sector growth. Industrial demand will become the number one driver for energy demand (fossil fuels and electricity) by 2020.¹⁵²

This rapid industrialization should be accompanied by labor migration from rural to urban areas. But, despite its monstrous growth rate, Vietnam has one of the lowest per capita energy consumption rates in the region. The significance of this trend is that the populace has not yet reaped the full benefits of development and thus has not experienced a dramatic jump in electricity demand due to urbanization. As economic development continues in Vietnam and the populace begins to improve their quality of life, the

¹⁵⁰ Asia-Pacific Economic Cooperation (APEC), *APEC Energy Demand and Supply Outlook 2006: Thailand*, Asia Pacific Energy Research Center (Tokyo, 2006), 95–97, <http://www.ieej.or.jp/aperc/outlook2006.html> (accessed December 23, 2008).

¹⁵¹ DOE, "Country Analysis Brief: Indonesia."

¹⁵² Asia-Pacific Economic Cooperation (APEC), *APEC Energy Demand and Supply Outlook 2006: Vietnam*, Asia Pacific Energy Research Center (Tokyo, 2006), 105–110, <http://www.ieej.or.jp/aperc/outlook2006.html> (accessed December 23, 2008).

urbanizing effects on electricity demand will become more apparent and demand will go up significantly. Strong income growth will raise standards of living and require more electricity for lighting, appliances, and other urban necessities. As the country gets richer, the government will increase the level of electrification to the rural areas and improve infrastructure in urban and developed areas. This will give more people access to electricity and, again, contribute to raising consumption.¹⁵³ Faced with this mounting challenge, Vietnam is looking to nuclear energy to diversify its energy portfolio and help meet anticipated growth in electricity demand. If the program is successful, it can be expanded to produce a greater share of electricity in the future. Vietnam is so confident of the viability of this energy source that they have made plans for four nuclear power plants without first seeing how one will perform.

C. AVAILABILITY OF ALTERNATIVE ENERGY SUPPLIES

Indonesia, Thailand and Vietnam are not without natural resources for energy production. However, each country has specific limitations on its resources, and these constraints encourage them to explore nuclear energy as an alternative.

1. Indonesia

At present, Indonesia is energy self-sufficient but this situation will not last much longer. Indonesia is the world's largest LNG exporter. It has coal, oil and other energy resources as well, but all of Indonesia's resources are very distant from the population centers on Java. Indonesia is the fourth most populous country in the world and the breadth of Indonesia is comparable to the North American continent. Getting energy resources from their origins to the metro centers for consumption is part of the problem.¹⁵⁴ This transportation process also takes energy, and adds to the final cost of producing energy for consumption. This rise in cost makes nuclear energy more

¹⁵³ APEC, *APEC Energy Demand and Supply Outlook 2006: Vietnam*, 105–109.

¹⁵⁴ M.S. Ardisasmita, Director of Center for Development of Information Technology and Computation, National Nuclear Energy Agency, Jakarta, "Preservation and Enhancement of Nuclear Knowledge Toward Indonesia's Plan to Operate First Nuclear Power Plant By 2016," International Conference on Nuclear Knowledge Management report no. IAEA-II-CN-123, Saclay, France, September 2004.

competitive because the availability of these resources is limited by the great distance they must travel. Although exploration has increased the estimated natural gas reserves in Indonesia, the majority of gas sources are located in places that require gas liquefaction. This is an expensive process and drives the price of natural gas up. Only a small fraction of Indonesia's gas fields are near Java. Furthermore, about 56.6% of Indonesia's annual gas production is exported; only the remainder is used for domestic consumption.¹⁵⁵

Coal is a resource that Indonesia also has in abundance and can be found in Kalimantan and Sumatra. Indonesia is looking to increase the share of coal in electricity generation in order to conserve its gas resources and make up for its declining oil reserves. Of the expanding generation capacity expected in Indonesia up to 2030, coal power is expected to account for 54% of this new capacity. By 2030, coal will generate 49% of Indonesia's electricity. Natural gas's share is expected to rise from about 30% to 39%. The electricity sector is already the number one consumer of natural gas in the nation. In the 1990s, Indonesia began looking to natural gas to offset the country's declining oil production. Now it is looking to coal to absorb the rest in order to manage its natural gas reserves. Indonesia is expected to be a net energy imported by 2030 and it is looking to Malaysia for its future energy needs.¹⁵⁶

By looking to nuclear energy now, Indonesia is hedging for its future. To wait until 2030 to explore this alternative would be too late and poor state planning. If nuclear energy proves to be a successful avenue of energy portfolio diversification, Indonesia can give nuclear energy a larger share of electricity generation specifically in its densely populated areas on Java.¹⁵⁷ As stated earlier, it already has plans for four nuclear power plants in the works. Pipelines and liquefaction processes for natural gas are expensive. Transporting coal to metro centers burns oil. Plus the longevity of these two resources

¹⁵⁵ APEC, *APEC Energy Overview 2007: Indonesia*, 61–73.

¹⁵⁶ Andrew Symon, "Southeast Asia's Nuclear Power Thrust: Putting ASEAN's Effectiveness to the Test", *Contemporary Southeast Asia* 30, no. 1 (2008): 120, <http://muse.jhu.edu.libproxy.nps.edu> (accessed 31 Jul 2008); APEC, *APEC Energy Demand and Supply Outlook 2006: Indonesia*, 33–37; DOE, "Country Analysis Brief: Indonesia."

¹⁵⁷ Ardisasmita.

cannot compare to nuclear energy. What nuclear energy brings to the table for Indonesia is a reduction in electricity costs to its major population centers on Java by mitigating the transportation costs of coal and gas. As electricity demand for these major areas goes up, a nearby nuclear plant will prove to be a better option than bringing coal and gas in from distant locations. This option also reduces Indonesia's electricity dependence on fossil fuels, and frees up more coal and natural gas for export.

2. Thailand

Unlike Indonesia, Thailand does not have a wealth of indigenous energy resources to meet its large demand for electricity. It is expecting to see vast increases in demand over the next two decades. Thailand's peak electricity demand is expected to increase to 56 GW by 2021. At present Thailand's predominant source of electricity is natural gas imported from Burma, Indonesia and Malaysia. In fact, natural gas accounts for 80% of Thailand's electricity production. In order to reduce dependence on imported natural gas, Thai governments have begun to examine the possibility of expanding electricity generation capacity using coal, but domestic coal lacks the caloric value necessary for electricity production. So, again this means relying on imports and does not break the dependence on imported energy. The advantage that coal offers is that it is cheaper than natural gas. However, since public views on coal-fired plants are negative because of the health and environmental implications, augmenting the energy portfolio with coal has faced stiff opposition.¹⁵⁸

Thailand is also buying hydro-electricity power from neighboring Laos. Contracts for future hydro-electricity purchases from Burma and China have already been negotiated and signed. The general trend of Thailand's available alternatives to nuclear energy is through purchasing agreements and memorandums of understanding (MOU) with its resource rich neighbors.¹⁵⁹ This makes Thailand's energy security position very

¹⁵⁸ Asia-Pacific Economic Cooperation (APEC), *APEC Energy Overview 2007: Thailand*, Asia Pacific Energy Research Center (Tokyo, 2006), 153–159, <http://www.ieej.or.jp/aperc/2007pdf/Overview2007.pdf> (accessed February 4, 2009); APEC, *APEC Energy Demand and Supply Outlook 2006: Thailand*, 95 – 99.

¹⁵⁹ Thailand Power Development Plan 2007–2021, 26–38; APEC, *APEC Energy Overview 2007: Thailand*, 153–159; APEC, *APEC Energy Demand and Supply Outlook 2006: Thailand*, 95–99.

weak and dependent on others. The lack of indigenous energy resources when compared to consumption rates is good reason for Thailand to look to nuclear energy for future electricity needs. Nuclear energy may be Thailand's ticket away from its dependence on imported energy. Like Indonesia, nuclear power will undergo a trial period and will only be a small fraction of Thailand's near-term energy growth.

3. Vietnam

Vietnam has alternatives to nuclear energy for electricity production, but the reliability of its primary alternative is less than consistent. In the 1990s, Vietnam generated 62% of its electricity from hydro-electric sources in the north. Oil and gas made up 20% and coal made up 17% of the remaining capacity. Vietnam's installed generation capacity was greater than its consumption, when all sources were available. However, hydro-power in North Vietnam proved unreliable because of seasonal effects and droughts. As a result, Vietnam had to import hydro-electric power from Laos, Cambodia and China to augment its domestic supply of electricity. To address this issue, Vietnam has been increasing the share of coal and natural gas in its generation portfolio. Today, Vietnam's electricity generation shares by fuel type is 46% natural gas, 26% coal, about 15% hydropower and 11% oil.¹⁶⁰

Vietnam's exploration efforts since the 1990s have uncovered vast amounts of natural gas and coal. This find supports Vietnam's energy move to reduce its share of hydropower with shares of natural gas and coal power. Exploration efforts have been so fruitful that Vietnam has become an exporter of energy and receive a healthy revenue stream from this industry. With these newfound sources of energy, does Vietnam still have a need for nuclear energy? Looking at available alternatives alone and the answer might be no. But when combined with the anticipated electricity demand in Vietnam's near future, it is clear that a significant need still exists. Even with these indigenous

¹⁶⁰ Gunn; Central Intelligence Agency, The World Factbook: Vietnam, "Geography, People, Government and Economy Information," (2009), <https://www.cia.gov/library/publications/the-world-factbook/geos/vm.html> (accessed February 9, 2009); Asia-Pacific Economic Cooperation (APEC), *APEC Energy Overview 2007: Vietnam*, Asia Pacific Energy Research Center (Tokyo, 2007), 170–171, <http://www.ieej.or.jp/aperc/2007pdf/Overview2007.pdf> (accessed February 4, 2009).

sources of energy, Vietnam is still expected to become a net importer of energy by 2020 because of its monstrous growth rate. Recognizing this challenge, Hanoi plans to bring 48 GW of generation capacity on line between 2006 and 2015 (2,000 MW of which will be from nuclear power). That is more than double the 2005 capacity of 12 GW. An additional 120 GW of generation capacity is planned for 2025, 6,000 MW of which will be by nuclear power.¹⁶¹ Simply put, Vietnam does not believe that its bountiful, indigenous energy sources will be enough for the coming electricity demand, and it would be correct.

D. POLITICAL WILL

By committing to nuclear energy development, these three countries have demonstrated that they have the political will to pursue nuclear energy. So this section will examine the political reason behind that decision and any domestic opposition that can diminish the political will to pursue nuclear energy. These three countries include a democratic government, an authoritarian government, and a government in turmoil. This sample will provide a wide range of variation on how different types of governments approach nuclear energy.

1. Indonesia

Indonesia has been pursuing nuclear energy off and on since the 1950s. Looking at the combination of future electricity demand and the increasing costs of available alternatives, the need for nuclear energy development in Indonesia is more apparent than ever. But this justification is not enough for some Indonesians who feel the associated risks of nuclear energy outweigh the benefits, and they have a voice. Present day Indonesia is a democracy with relatively open media and press. Free elections in October 2004 installed the current Yudhoyono administration. These trends make Indonesia one of the most democratic countries in Southeast Asia. This democratic character has emboldened societal actors to participate in shaping Indonesia's energy policy through

¹⁶¹ APEC, *APEC Energy Overview 2007: Vietnam*, 170–171.

intermediate associations. The intermediate associations in Indonesia for both sides have been publically debating the issues on nuclear safety openly and fiercely.¹⁶²

In Indonesia, both preferences for and against nuclear energy development have powerful intermediate associations representing their interests to the central government. Indonesia has a long-standing, civilian-controlled National Atomic Energy Agency (BATAN). This agency has deep roots in peaceful application and development of radioisotope and nuclear technology. It has survived multiple regime changes and has always been seen as a nationalist civilian institution that is outside of politics.¹⁶³ BATAN is the intermediate association that represents the preference for nuclear power in Indonesia. It is trying to raise the level of awareness and distribute updated information on nuclear power safety to the general public to address their safety concerns. Modern nuclear plants are safer and more reliable than those in previous decades. BATAN will look to Japan and South Korea as examples of how safe nuclear energy can be, especially the Kashiwazaki-Kariwa Nuclear Power Plant. Here a Japanese nuclear plant withstood an earthquake beyond its seismic rating with no significant damage. The IAEA reported that the plant was safe for operations in 2009.¹⁶⁴ Its ability to sway public acceptance of nuclear energy will be critical if Indonesia is to proceed with nuclear energy development.

The main forces opposing nuclear energy in Indonesia are represented by a coalition between the Islamic religious group Nahdlatul Ulama (NU) and the Friends of Earth Indonesia (WALHI). This opposition to nuclear energy in Indonesia has two major concerns. The first concern is the designated location for the first nuclear plant near Mt. Muria, a dormant volcano. The second concern is that the Indonesian government lacks the capability to safely operate a nuclear plant without significant, negative environmental impacts. The NU is one of the most powerful religious groups in

¹⁶² Malley and Ogilvie-White, 12–13.

¹⁶³ Symon, “Southeast Asia's Nuclear Power Thrust: Putting ASEAN's Effectiveness to the Test,” 125; Malley and Ogilvie-White, 9–11.

¹⁶⁴ International Atomic Energy Agency (IAEA), “Third IAEA Report on Kashiwazaki-Kariwa Nuclear Power Plant Published,” *Kashiwazaki-Kariwa Nuclear Plant Indicated Safe Performance of the Plant Staff Report*, January 2009, <http://www.iaea.org/NewsCenter/News/2009/kashiwazaki290109.html> (accessed May 7, 2009).

Indonesia and many of the locals near Mt. Muria are members of this group. The NU have declared the nuclear power plant site at Mt. Muria to be “haram” or forbidden.¹⁶⁵ NU’s opposition against nuclear power stems mainly from the potential dangers of a nuclear power plant near this dormant volcano and what that means for its followers nearby. Although Indonesia is non-secular, it is the world’s largest Islamic country by population. Its government is greatly influenced by religious groups.

WALHI’s concern is focused on environmental conservation. It feels that an Indonesian nuclear power plant will have significant environmental impacts which will adversely affect the ecology. Many Indonesian economic sectors such as fishery and agriculture are ecologically dependent.¹⁶⁶ Adverse ecological impacts mean adverse financial conditions for these sectors. One hotly debated example of the safety issue is Indonesia’s poor public infrastructure safety record as evident by the 2006 official statistics on air and rail transportation crashes and accidents. Indonesians fear that their government will have the same track record in nuclear power.¹⁶⁷ Add to this the numerous natural disasters to which Indonesia is prone and safety becomes a very hot issue. The average Indonesian is also concerned about the government’s ability to keep nuclear power plants safe from inept operators and natural disasters. The anticipated site of Indonesia’s first nuclear power plant is less than ideal in the eyes of the people. The majority of the country is in an earthquake zone because most of Indonesia is on the edge of the “Ring of Fire.” This site is located near a dormant volcano, and in an earthquake zone.¹⁶⁸ The second safety debate is centered on security of nuclear facilities against Indonesia’s security realities. Indonesia is a transit point for transnational terrorist, and Indonesia’s internal security issues involving separatists are not completely put to bed. A nuclear facility may prove to be a vulnerable and juicy target. These security issues

¹⁶⁵ Malley and Ogilvie-White, 8; Neil Hickey, “A Nuclear Indonesia?” *Energy Tribune*, May 19 2008, <http://www.energytribune.com/articles.cfm?aid=898> (accessed December 5, 2008).

¹⁶⁶ “The nation must ensure the safety of the people from ecological disaster,” *Friends of the Earth Indonesia (WALHI) online*, http://www.eng.walhi.or.id/kampanye/psda/070702_ipc_cu (accessed December 5, 2008).

¹⁶⁷ Malley and Ogilvie-White, 8–9, 13.

¹⁶⁸ Andrew Symon, *Nuclear Power in Southeast Asia: Implications for Australia and Non-Proliferation* (Lowy Institute for International Policy [2008]): 5, 10–11.

further enflame the safety debate. This open debate gives leverage to those opposing nuclear energy, and democracy gives the political room for them to use this leverage. Although WALHI and NU offer a lot of opposition, they do not offer any realistic solutions to the energy pressures. This is a significant weakness in their position.

This splits the preferences on nuclear energy in Indonesia. Jakarta referees between these two competing preferences and currently favors nuclear energy development because of the emerging energy demand pressures. Some Indonesians are for it and others, including the locals around Mt. Muria, are against it.¹⁶⁹ The democratic nature of Indonesia allows both sides to voice their views and does not disenfranchise one group or another. In the developing world, environmental concerns are often trumped by need. It is unlikely that Indonesia will turn away from nuclear energy under pressures from WALHI and NU in the face of mounting electricity demand. Instead, Indonesia will continue its cautious progress towards nuclear energy development. It will use the time afforded by this cautious advance to promote nuclear energy and build confidence in its public.

2. Thailand

Thailand shows no indication of having the same cleavage among its urbanites as in Indonesia. The general trend in Thailand is that the societal actors care more about the current political turmoil than the debate on nuclear energy. Both sides of the political conflict recognize the necessity of nuclear energy in light of Thailand's expanding electricity demand and lack of available resources. This is evident by Thailand's consistent stance on nuclear energy throughout the various governments in power since before the 2006 coup to today.¹⁷⁰ The Electricity Generating Authority of Thailand (EGAT) asserts that nuclear energy is necessary because of future shortfalls of natural

¹⁶⁹ Malley and Ogilvie-White, 8.

¹⁷⁰ Office of Atoms for Peace, <http://www.oaep.go.th/english> (accessed December 12, 2008); International Atomic Energy Agency (IAEA), "Nuclear Power As An Engine for Development: IAEA Chief Addresses Nuclear Power's Outlook in Talks in Thailand and Malaysia," *International Atomic Energy Agency News Center*, http://www.iaea.org/NewsCenter/News/2007/dg_thaimalay.html (accessed December 12, 2008); *Inaugural Address by His Excellency Mr. Samak Sundaravej, Prime Minister of the Kingdom of Thailand*, April 28, 2008.

gas expected in the next three to four years.¹⁷¹ The societal preference in Thailand for nuclear energy appears to be unopposed for now. Once the political smoke clears, and the debate on nuclear energy enters the public domain, this may change. It is expected that the “Yes I’d like to have nuclear energy, but not in my backyard,” syndrome will take root in Thailand once the location of the first nuclear power plant is announced.

Thailand’s *intermediate associations* are in flux since the conflict between the Royalists and the Thaksinites have yet to play out. The battles between these two factions have overshadowed the nuclear energy issue. There is a lack of high-level debate and both sides have not developed a dedicated position on the issue beyond a general sense of support. The preference for nuclear energy in Thailand is represented by the EGAT, a bureaucratic entity that is apolitical and continues to march along its planned path to nuclear energy development. The ASEAN Plus Three meetings hosted by Bangkok in the summer of 2008 discussed the issues of nuclear power and alternative energy sources extensively. This indicates that the Thai government is still making headway on their nuclear plan as guided by EGAT, despite the ongoing political turmoil. EGAT issued a Power Development Plan in January 2008 with a timetable for both nuclear power plant projects (EGAT # 1-2, and EGAT # 3-4).¹⁷² As other intermediate associations are in turmoil, EGAT will pursue its plan to the extent possible under the current political situation while receiving little political oversight and assistance. This explains why Thailand is crawling towards nuclear energy at a snail’s pace. The benefit to this slow crawl is that continual progress will build momentum over time unnoticed and unchecked by opposing intermediate associations. If and when Thailand emerges from its political crisis, this momentum may be too great to steer away from nuclear energy development.

3. Vietnam

Vietnam, like Thailand, shows no indications of having a cleavage among societal actors on the nuclear energy issue. Initial thinking may attribute this to the control of an

¹⁷¹ Gunn.

¹⁷² Thailand Power Development Plan 2007–2021, 9, 18, 48.

authoritarian regime over its populace,¹⁷³ but the Vietnamese people have just as much to gain from nuclear power if not more than their energy-hungry neighbors in Thailand and Indonesia. Vietnam's rate of economic growth has been staggering, and the development of more electricity generating capacity will only perpetuate this trend.¹⁷⁴ This phenomenon may give more credence to preference for nuclear energy if open debates were allowed. Demonstrating an ability to achieve this technological feat would be a bright feather in its cap. Foreign investors may also see this as developmental progress in the right direction and become even more eager to do business in Vietnam, again contributing to Vietnam's economic growth. Although this is speculation, it is not outside the realm of possibility under the current situation. At present the only societal actors in Vietnam that matter are those tied to Vietnam's ruling regime (the communist party) and they have clearly expressed their preference in favor of nuclear energy development.

Vietnam, as an authoritarian communist country, has only one intermediate association in nuclear power development. The Vietnam Atomic Energy Commission (VAEC) is the representative of the preference for nuclear power in Vietnam. The VAEC falls under the Ministry of Science and Technology branch of the Vietnamese Communist Party (VCP).¹⁷⁵ No open source data was found on the VAEC that did not originate from the state. Vietnam's intermediate association in favor of nuclear energy (the VAEC) will remain completely supported and unopposed as long as the VCP remains in power. This factor is consistent with the speed at which Vietnam is barreling towards nuclear energy.

E. ADEQUATE MEANS OF PRODUCTION TO DEVELOP NUCLEAR POWER

All three countries in this chapter have sufficient means of production to develop nuclear power. In the area of capital, Indonesia and Thailand are strong economies in the

¹⁷³ Gunn, "Southeast Asia's Looming Nuclear Power Industry."

¹⁷⁴ Malley and Ogilvie-White, 17–19.

¹⁷⁵ Vietnam Atomic Energy Commission Database, <http://www.vaec.gov.vn/> (accessed December 5, 2008).

region. Indonesia has earmarked \$8 billion for the four nuclear plants it plans to construct by 2025. Indonesia exports a large amount of energy resources (oil, coal and natural gas) and earns significant revenue from it. Thus, it is not difficult to see why it has sufficient capital. Indonesia's economy under the Yudhoyono presidency has done well with robust economic growth and solid fiscal stewardship. The 2009 global recession will stunt the economy's upward trend to some extent, but not seriously enough to deter Indonesia from its nuclear power path.¹⁷⁶

Thailand's political turmoil has crossed over into the economic sphere and eroded investor confidence. Even the tourism industry, one of Thailand main staples, has been crippled by recent events.¹⁷⁷ The global recession will dampen economic recovery even more and may delay budgeting allocations for plant construction. But all the while EGAT is moving along with its nuclear energy plans without much notice. It is still in the preparatory phase of development and has not yet reached the point for funding allocations toward construction. The key point to keep in mind is that the Thai economy was one of the strongest in Southeast Asia prior to the 2006 political crisis and the 2008 global recession, so the starting point for this economic decline has some cushion. If the politics of Thailand can be resolved, economic improvements, if not recovery, should be quick to follow. Even with events as they are, Thailand still reported GDP in the range of \$500 billion during 2006, 2007 and 2008 with a slight upward trend.¹⁷⁸ At present, Thailand is facing economic difficulties that may result in delaying capital for its pursuit of nuclear energy, but capital will not be the limiting factor in the long run.

The Vietnamese economy is another Southeast Asian success story. It has been one of Asia's fastest growing economies since 2001 with exports to the United States increasing by 900% from 2001 to 2007. The poverty level in Vietnam has declined to

¹⁷⁶ Symon, "Southeast Asia's Nuclear Power Thrust," 125–126; Central Intelligence Agency, *The World Factbook: Indonesia*; APEC, *APEC Energy Overview 2007: Indonesia*, 61–73.

¹⁷⁷ Zhu Li, "Political Turmoil Grooms Thailand's Outlook," *Xinhua Chinese News Agency*, 15 April 2009, http://news.xinhuanet.com/english/2009-04/15/content_11188902.htm (accessed May 8, 2009).

¹⁷⁸ Central Intelligence Agency, *The World Factbook: Thailand*; APEC, *APEC Energy Overview 2007: Thailand*, 153–159.

less than that of China, India and the Philippines.¹⁷⁹ The booming economy of Vietnam may face some challenges during the global recession started in late 2008, but Vietnam's commitment to nuclear energy will see that adequate capital is mustered and allocated to this project. It is of prime importance to future growth and the Vietnamese see this as an investment in that future growth.

An adequate labor force to support nuclear power exists in Indonesia and Thailand because these two countries are industrialized. Both have industries ranging from high-tech to light, and have large scale thermal energy based industries. This means that both have a trained and developed labor pool suited for construction of a nuclear power plant. It is from this industrial labor pool that the workforce for constructing a nuclear plant will be drawn. The labor force in Vietnam is a little more questionable. With a rapidly developing industrial base, has the Vietnamese workforce developed in parallel? In 2000, the technical labor force in Vietnam was assessed as not being of optimal ratio for the needs of a developing country. The ratio of three levels of technical workers from high to low broke out to 1:1.2:1.8. This indicates that there was a shortage of workers in the middle and lower technical level. These levels are the welders, mechanics, plumbers and foremen necessary in building a power plant.¹⁸⁰ But the key point is that those skilled technical workers exist in Vietnam. With its ability to direct resources and manpower, Hanoi should be able to muster sufficient technical labor to pursue a nuclear program. Since the 2000 study, the technical workforce in Vietnam is only expected to get better and larger because of the economic growth it experienced.

¹⁷⁹ Central Intelligence Agency, The World Factbook: Vietnam.

¹⁸⁰ An Nhö Haûi, "Technical Labor: A Decisive Factor for the Economic Growth," University of Economics, Ho Chi Minh City, 2000, www.ueh.edu.vn/tcptkt/english/2000/thang9/techni.htm (accessed May 8, 2009).

F. TECHNICAL CAPACITY

Indonesia, Thailand and Vietnam have had a hand in nuclear technology since the 1960s with roots going back to the Atoms for Peace program.¹⁸¹ Each country has a government agency that has been operating a research reactor for peaceful purposes for years. Each country has sufficient technical capacity for nuclear energy development, but each also faces specific challenges unique to its domestic environment.

Indonesia's BATAN has been involved in nuclear technology for about five decades, and operates three research reactors with a fourth in the works. It has worked extensively with the IAEA in the Technical Cooperation (TC) program. It has completed 124 TC projects and is active in 17 TC projects. Of these 141 TC projects, 89 are applicable to nuclear energy development. Indonesia has the highest number of TC projects with the IAEA in Southeast Asia and over 50% of them relate to nuclear power.¹⁸² A problem that BATAN is facing is the brain drain associated with an aging work force. To replenish the retiring experts and specialist, BATAN must recruit and train replacements. But it has to also compete with other technical industries for these recruits, which hurts its gain numbers. Once recruits have established a productive level of knowledge, BATAN has to fight to retain them against those same industries to keep its developing or developed talents.¹⁸³ Although this is a challenge for BATAN throughout the career progression of its members, it is not anticipated that this obstacle will prevent it from successfully developing nuclear energy.

Thailand is another country with heavy involvement in nuclear technology. The Office of Atomic Energy for Peace (OAEP) was established in 1961 and changed its

¹⁸¹ Malley and Ogilvie-White, 10; Symon, "Nuclear Power in Southeast Asia," 4; Badan Tenaga Nuklir Nasional (BATAN), Indonesia Nuclear Agency Database, <http://www.batan.go.id/en2008/profil.php> (object name BATAN Profile: BATAN History; accessed May 11, 2009); Thailand Ministry of Science and Technology (MOST) Database, http://www.most.go.th/engCMS/index.php?option=com_content&task=view&id=60&Itemid=81 (object name Office of Atoms for Peace; accessed May 11, 2009); Ralph Vartabedian, "A Race with the Terrorist," Los Angeles Times, Edition A-1, September 27, 2007, Los Angeles Time, via Lexis-Nexis, <http://www.lexisnexis.com> (accessed August 2, 2008).

¹⁸² International Atomic Energy Agency (IAEA) database, <http://www-TC.project.iaea.org/TC/projectweb/default.asp> (object name Department of Technical Cooperation; accessed July 25, 2008).

¹⁸³ Ardisasmita; Gunn.

name to the Office of Atoms for Peace (OAP) in 2003.¹⁸⁴ It has worked with both the IAEA through the TC program and the United States through the Atoms for Peace program primarily focusing on agricultural and medical applications. Recent energy pressures have shifted Thailand's nuclear technology focus to energy production. This means that Thailand is behind Indonesia in the pursuit nuclear energy, but its relationship with the IAEA is just as deep. Thailand has completed 93 TC projects and has 13 TC projects active. Of these 106 projects 46 are applicable to nuclear energy development. Of the 13 TC projects currently active, only 4 do not have nuclear energy applicability.¹⁸⁵ The political turmoil has left the OAP relatively untouched and allows it to go about its business unhindered. The scientific and bureaucratic expertise in Thailand pertaining to nuclear energy development has slowly progressed since the 1960s. Today sufficient technical capacity exists to develop nuclear energy even in the face of political turmoil.

South Vietnam was part of the Atoms for Peace program started in the early 1960s. The Da Lat research reactor was built in 1963 by General Atomic based in San Diego and ran with U.S. assistance and fuel until the waning days of the Vietnam War. After Vietnamese reunification, the Vietnamese ran Da Lat with Soviet fuel and assistance.¹⁸⁶ The Vietnam Atomic Energy Commission (VAEC) has been around since 1976 and IAEA records show cooperation with Vietnam going back to 1971. Vietnam's technical capacity has come a long way since the 1970s. Like Thailand, Vietnam's early nuclear technology focus was on agriculture and medical applications. Since liberalization, energy has become a paramount concern for this developing country and interests in nuclear energy production grew. Vietnam has completed 79 TC projects with the IAEA and has 16 active projects. Of the 95 total projects, 51 have nuclear energy applicability and of the 16 active projects, half deal with nuclear energy. An official from the IAEA's Division of Nuclear Power has expressed confidence in Vietnam preparation for nuclear power development and states that the IAEA stands ready to

¹⁸⁴ Thailand MOST; Thailand OAP Database.

¹⁸⁵ International Atomic Energy Agency (IAEA) database, <http://www-TC.project.iaea.org/TC/projectweb/default.asp> (object name Department of Technical Cooperation; accessed July 25, 2008).

¹⁸⁶ Vartabedian, "A Race with the Terrorist."

assist.¹⁸⁷ Vietnam is the most aggressive pursuer of nuclear energy in Southeast Asia and this aggression can be seen in the timeline for its first two power plants. The pace at which these plants are to come online may outstrip the rate at which technical capacity in the form of human capital can be developed. The Chairman of the VAEC, Tran Huu Phat, has highlighted human resource deficiencies that need to be overcome if Vietnam is to meet its timeline for its first two reactors.¹⁸⁸ With undeterred state backing, Vietnam has amassed significant technical capacity to realistically pursue nuclear energy development but still face some human resource shortfalls that may delay development.

G. INTERNATIONAL SUPPORT

Based on the threat perception in the region and the genuine need for nuclear power, these countries are not seen as proliferation threats and international support of their nuclear energy ambitions is forthcoming from the technology holders in the international community. Indonesia and Thailand have a relatively benign security threat environment with other countries in the region and no sovereignty issues that can pull either country into total war with its neighbors. Current Thai-Cambodian tensions over the sovereign claim of a temple have led to some security force clashes, but it is very unlikely that the two countries will commit to war over the issue. Primary security issues of significance in Indonesia and Thailand are of a domestic nature involving insurgency and terrorism.¹⁸⁹ Both cases lack the motive for nuclear proliferation based on security needs.

¹⁸⁷ IAEA database, Department of Technical Cooperation; “Vietnam announces plan to build two nuclear power plants in central province,” BBC Worldwide Monitoring, November 3, 2008, via Lexis-Nexis, <http://www.lexisnexis.com> (accessed December 5, 2008).

¹⁸⁸ Mark Hibbs, “More milestones set in 2009 for first two Vietnamese reactors,” *Nucleonics Week* 49.44, October 30, 2008, 17, via Lexis-Nexis, <http://www.lexisnexis.com> (accessed December 5, 2008).

¹⁸⁹ Donald E. Weatherbee, “Conflict and Conflict Resolution in Southeast Asia,” and “Terrorism and Transnational Crime in Southeast Asia,” in *International Relations in Southeast Asia* (Oxford: Rowman and Littlefield, 2005) 120–124, 140–145, 156–186; Simon Montlake, “Why the Thai-Cambodian Temple Dispute Lingers,” *The Christian Science Monitor*, July 22, 2008, <http://www.csmonitor.com/2008/0722/p06s02-wosc.html> (accessed May 11, 2009); Statement by Dr. Desra Percaya Delegates of the Republic of Indonesia at the General Debate of the First Committee of the 63rd Session of the United Nations General Assembly, October 7, 2008, (acquired from <http://www.reachingcriticalwill.org/> accessed January 15, 2009).

Vietnam's case is a little more complex. It has sovereignty disputes with nuclear capable China over the Paracel and Spratly Islands. The reason behind these disputes is the potential fossil fuel resources in the South China Sea. The last time these two countries fought, Vietnam had a battle-hardened military fresh from conflict with the U.S. military while China had a poorly trained antiquated force. The result was decisively in favor of the Vietnamese. Since then, China has modernized and professionalized its military while the Vietnamese military atrophied without Soviet support. Nuclear weapons may be seen as an equalizer for Vietnam if it had to face China today. But Vietnam has seen the benefits of cooperating with China to explore these resources through the actions of the Philippines. It is more beneficial to share the resources if it means getting to them faster. This prospect mitigates the chance of a war with a militarily superior China and instead pushes for cooperation. Ironically, China is one of the country with which Vietnam has a nuclear cooperation agreement. Vietnam has also abandoned ambitions of regional hegemony over Indochina and has pursued a more benign foreign policy towards its neighbors since 1991. This situation greatly reduces Vietnam's need for a nuclear weapon.¹⁹⁰ Vietnam has also demonstrated a willingness to work with the U.S. Global Threat Reduction Initiative (GTRI) to secure weapons grade uranium. The VAEC and GTRI worked together to remove weapons grade uranium fuel rods from the Da Lat research reactor and replaced it with low enriched uranium fuel rods. The weapons grade material was sent back to Russia, the country of origin, for reprocessing into lower grade uranium fuel.¹⁹¹ This case further supports Vietnam's intent on peaceful applications of nuclear technology.

The compliance and promotion of nonproliferation norms by these three countries further engender the international support of their efforts. All three countries are signatures to the Nuclear Nonproliferation Treaty (NPT), The Comprehensive Test Ban Treaty, and the Bangkok Treaty establishing a Southeast Asia Nuclear Weapons Free Zone (SEANWFZ). All three countries have also agreed to the IAEA Safeguards and

¹⁹⁰ Weatherbee, 57–87, 128–129, 133–139; Malley and Ogilvie-White, 17–23; Hibbs, 17.

¹⁹¹ Vartabedian, "A Race with the Terrorist."

Verification regime, and the IAEA Additional Protocol.¹⁹² These assurances provide the international community with confidence that Indonesia, Thailand and Vietnam will not develop nuclear weapons and the electricity demands in all three countries underscore their genuine need for nuclear power.

Now that it is plain why the international community would not be opposed to assisting these three countries, the reasons why support should be provided needs to be discussed. Aside from the idea that economic development and growth in this region is generally good for Asia and the world, certain technology holders such as the United States, Russia, France, Japan and South Korea have developed a nuclear industry for export. These countries do it because it is profitable, and because they are discovering that their domestic consumption of this industry is insufficient to keep the industry going and are looking to a foreign market to make up the difference.¹⁹³ Indonesia has already contracted a feasibility study to a South Korean company in concert with PT Medco Energi International.¹⁹⁴ Thailand's EGAT is evaluating four international firms for the contract on its nuclear power plants. The candidates so far are France, The United States and two Japanese companies.¹⁹⁵ It is speculated that the political situation in Thailand has pushed this decision indefinitely to the right. Vietnam is building numerous relationships with technology holders similar to Thailand and Indonesia. They include Canada, China, France, Japan and South Korea.¹⁹⁶ International support to these three

¹⁹² United Nations, "Status of Multilateral Arms Regulation and Disarmament Agreements," United Nations (UN), <http://disarmament.un.org/TreatyStatus.nsf> (accessed April 3, 2009); International Atomic Energy Agency, "Safeguards and Verification," International Atomic Energy Agency (IAEA), http://www.iaea.org/OurWork/SV/Safeguards/sg_protocol.html (accessed April 3, 2009); Association of Southeast Asian Nations, *Treaty on the Southeast Asia Nuclear Weapon-Free Zone Bangkok, Thailand*, 1995, <http://www.aseansec.org/2082.htm> (accessed April 2, 2009); Comprehensive Nuclear-Test Ban Treaty Organization, Member States, Status of Signature and Ratification database, <http://www.ctbto.org/the-treaty/status-of-signature-and-ratification/> (accessed April 1, 2009).

¹⁹³ Gunn.

¹⁹⁴ Symon, "Southeast Asia's Nuclear Power Thrust," 126; Malley and Ogilvie-White, 7-8.

¹⁹⁵ Reuters, "Four Firms Eyes Thai Nuclear Power Plant Project," *Thomson Reuters*, January 11, 2008, <http://www.reuters.com/article/rbssConsumerGoodsAndRetailNews/idUSBKK31050420080111> (accessed May 7, 2009).

¹⁹⁶ Hibbs, 17.

countries is readily available and forthcoming because of the potential profits involved, and the fear of proliferations has been greatly reduced by the actions and trends of these three countries.

H. CONCLUSION: EACH COUNTRY'S ROAD TO NUCLEAR ENERGY

For Indonesia, Thailand and Vietnam the most significant factors in their decisions to pursue nuclear energy development was their need, in other words a growing gap between growing electricity demand and the declining availability of non-nuclear alternatives. Thailand had the greatest need in that it consumed about as much electricity as Indonesia without the energy resource wealth of Indonesia. Also, the size of Thailand's population is only a fraction of Indonesia's population, meaning that per capita, Thailand consumes more electricity. Vietnam had the smallest need in terms of electricity demand and available resources. However, once these countries made the decision to pursue nuclear energy, other factors became paramount in affecting how each country approached this national objective. As in chapter III, political will was a dominant factor that affected the pace at which each country marched towards nuclear power development. But unlike the previous chapter, technical capacity was the other dominant factor and especially contributed to setting the pace of nuclear development in Vietnam.

If these countries were categorized from most aggressive to least aggressive in their pursuit of nuclear energy, the lineup would be Vietnam, Indonesia and Thailand respectively. This order also corresponds to the level of political will each country has for nuclear energy development. Vietnam is by far the most aggressive, jumping into this race as the least developed of the three countries. The authoritarian nature of the Vietnamese government coupled with an overwhelming desire for continued economic growth provides tremendous motivation for its nuclear development program. Limiting its rate of advance is its human capital margin in technical capacity. Although Vietnam has sufficient technical capacity to develop nuclear energy, it has a small margin on the human resource component of that technical capacity which can limit how fast its two nuclear power plants can be completed. Simply put, Vietnam needs more scientist and

engineers at this level. Vietnam is already the fastest pursuer of nuclear energy and it would like to advance at an even faster pace if it could. Greater investment in human resources can close this vulnerability in technical capacity.

Indonesia is a well-established democracy where opposition to official views is not treated with such a heavy hand. Here interest groups opposed to nuclear power development are competing with the government for influence of the general public's views on nuclear power. The Indonesian government is proceeding very slowly and cautiously with its nuclear power program while trying to win over the public. It must use BATAN to promote and disseminate information on the safety and reliability of nuclear power, and it must also overcome its own sorted reputation of poor public safety. It is an uphill battle for Indonesia to win public approval, but it is essential if nuclear power development is to be successful in Indonesia. Without the general support of its people, Indonesia's dream of nuclear power may be impossible to realize.

Thailand is in political turmoil, but this situation is not necessarily an obstacle for EGAT and OAP in their pursuit of nuclear power. All political attention is on the struggle between the Royalists and the Thaksinites. Under these conditions, slow progress on nuclear power development remains possible. No groups have voiced opposition, and the bureaucratic EGAT and OAP machines are progressing with their plans relatively unopposed. The only stops along this path are those requiring major government decisions, like budgeting, site approvals and awarding of contracts. Once EGAT and OAP reach any of these stops, they will have to either wait for the political situation to die down or attempt to slide the issue in for the approval of who every is in control of the government at the time. By doing the latter, EGAT runs the risk of drawing negative attention to itself if that controlling government loses power to the opposition. It is better to let things progress up to the stops and wait. This slows the progress of nuclear development significantly and may push the timeline indefinitely to the right until the political infighting is over.

Unlike Thailand, Indonesia and Vietnam do not face immovable political obstacles to nuclear energy progress. For where they are in their nuclear energy program development, the factor of technical capacity is the main obstacle that they must

overcome. Indonesia has been working on building this technical capacity for decades while Vietnam has only been focused on this effort for the past decade. Naturally, it is expected that Indonesia would have accrued sufficient technical capacity for developing nuclear energy while Vietnam may be a little short. The rate at which Indonesia is moving towards nuclear energy (as determined by political will) coupled with their technical capacity is a combination where the Indonesians can make up for any gaps in human resource that may occur before they need it. This cushion does not exist in Vietnam's case because of the aggressive timetable of their program.

Indonesia, Thailand and Vietnam are approaching nuclear energy development at different rates even though they face similar regional energy pressures. At this stage of development, the reason for variation in rate of development stems from the dominant factors of political will and technical capacity. Indonesia's political will for nuclear energy has some domestic opposition, but its technical capacity is sufficient for nuclear energy development. Vietnam has no opposition to its political will, but faces possible human resource problems that can dampen technical capacity. Thailand lacks political will to proceed beyond any points planned prior to the political crisis started in 2006, and will stall out once the program reaches these pre-planned points.

	Electricity Demand	Available Alternatives	Political Will	Means of Production	Technical Capacity	International Support
Indonesia	Large electricity demand that is expected to grow rapidly driven by urbanization and economic expansion	Oil and natural gas but both are running out. Coal is abundant	Advanced in preparation for nuclear energy. Some strong domestic groups oppose site of first nuclear power plant*	Adequate capital Adequate labor	Adequate technical capacity with 5 decades of nuclear technology research under BATAN.*	IAEA and international community
Thailand	Large electricity demand with expected growth tied to economic expansion	Insufficient domestic resources to supply demand without import	Political turmoil has drawn attention away from this issue, allowing the bureaucratic institutions to march on unnoticed*	Adequate capital Adequate labor	Adequate technical capacity with minor gaps that can be rapidly closed	IAEA and international community
Vietnam	Electricity demand driven by economic development	Diverse fossil and renewable energy resources	Economic growth tied to regime legitimacy.*	Adequate capital Adequate labor	Adequate technical capacity, but needs more human resource capacity to reduce the risk of delay	IAEA and international community

(*) The dominating factor in a country's decision on nuclear energy.

Table 3. Factors in Countries That Have Committed to Nuclear Energy

THIS PAGE INTENTIONALLY LEFT BLANK

V. CONCLUSION AND POLICY RECOMMENDATION FOR NUCLEAR ENERGY DEVELOPMENT IN SOUTHEAST ASIA

A. THE PURPOSE BEHIND THIS THESIS

This thesis evaluated the eleven Southeast Asian countries to ascertain the reasons why some have chosen to pursue nuclear power, while others have abstained. And among those that have opted for nuclear energy, it has identified the reasons why some are pursuing that goal more quickly than the others. The main reasons why nuclear energy development in Southeast Asia is significant are its potential contribution to sustaining economic growth, the safety concerns unique to this particular energy source, and the security concerns associated with nuclear material. The impact of these three factors on the regional stability in Southeast Asia emphasizes the importance of gauging nuclear energy development in Southeast Asia.

B. ANSWERING THE THESIS QUESTION

In order to analyze why some Southeast Asian countries have chosen to pursue nuclear power while others have abstained, this thesis evaluated six potential causes in each country: electricity demand; the availability of alternatives to nuclear energy; political will; the means of production; technical capacity; and international support. The hypothesis is that a country will pursue nuclear energy if it stands to gain more from the potential increase in electricity generation capacity than from other forms of large scale electricity sources when equal national effort is applied. The eleven Southeast Asian countries can be categorized into three groups: countries that have abstained from nuclear energy; countries that may pursue nuclear energy in the near future but are not doing so at the present; and countries that are pursuing nuclear energy. The categorization of each country is influenced mainly by just one or two of the six potential causes. Among those that have opted for nuclear energy, the factor of political will was the key determinant of how quickly that country is moving toward nuclear energy.

1. Countries That Have Abstained From Nuclear Energy

This is the largest of the three categories pertaining to the decision on nuclear energy. It consists of Brunei, Cambodia, Laos, Singapore and Timor-Leste. The general characteristics of the countries in this category fall under two types. The first type is an underdeveloped country where an increase in electricity generation capacity in the thousands of megawatt range does little to improve the social or economic situation. Countries in this sub-category are Cambodia, Laos and Timor-Leste. In these countries, the infrastructure for electricity distribution is so lacking that additional generation capacity would be almost pointless because the majority of the people would not have access to it. The dominant factor in these countries is the low demand for electricity because of a lack of distribution infrastructure. A close secondary factor contributing to their decision to abstain is the insufficient means of production (capital and skilled labor) to pursue a nuclear project because of its high initial cost of entry and its demand for skilled labor. In addition, these three countries have an abundance of alternatives to nuclear energy for large-scale electricity production. This factor is the coup de grâce that ensures these three countries will not turn to nuclear energy in the near future.

The second type of countries in this category is developed countries that have an overwhelming disposition against nuclear energy development. The two countries in this sub-category are Brunei and Singapore. The dominant factors keeping Brunei out of the nuclear energy game is its relatively small electricity demand in comparison with its enormous availability of fossil fuels (alternative to nuclear energy). Brunei's natural gas reserves are expected to satisfy its electricity consumption growth beyond the 2030 timeframe. Singapore is a different story. Here, the dominant factor is a lack of political will. Singapore has a high demand for electricity but because of its geographic limitations, it cannot satisfy the 30 km recommended safety standoff distance from nuclear power plants to urban centers.¹⁹⁷ This limitation makes nuclear energy an

¹⁹⁷ Lee Kwan Yew, Transcript of Minister Mentor Lee Kuan Yew's Dialogue with Singapore Energy Conference on November 4 2008, Raffles City Convention Centre, <http://www.news.gov.sg> (accessed November 19, 2008).

unsuitable solution to Singapore's electricity demand problem. Singapore will continue to be dependent on imported fossil fuel to meet its high electricity demand.

Countries that have abstained from nuclear energy do so because of a dominant factor that makes nuclear energy an unsuitable solution to their energy needs. Some countries have more than one factor that steer it away from nuclear energy while others (Singapore) have only one factor that greatly constrain it even though it has great need for energy.

2. Countries That May Potentially Pursue Nuclear Energy in the Near Future

There are countries in Southeast Asia that are sitting on the fence when it comes to nuclear energy. These countries are lumped together as countries that may potentially pursue nuclear energy in the near future. These countries include Burma, Malaysia and the Philippines. Burma is included because it is in the process of acquiring a 10 MW research reactor and starting a fledgling nuclear technology program.¹⁹⁸ If not for this milestone decision, Burma would be in the same category as Cambodia, Laos and Timor-Leste. The dominant factors in Burma's case are political will and international support. The unique issue regarding Burma is the apparent lack of clear purpose behind its pursuit of nuclear technology. Acquiring a 10 MW research reactor is not an earth-shattering event for the region. Indonesia, Malaysia, Thailand, the Philippines and Vietnam already have research reactors.¹⁹⁹ The concern is centered on such a reactor in the hands of an unpredictable, non-transparent military regime. Burma has low electricity demand because of the lack of distribution infrastructure much like Cambodia, Laos and Timor-Leste. It has abundant alternatives to nuclear energy for electricity generation. So the need for nuclear energy does not exist. Speculation about the motives behind Burma's

¹⁹⁸ Bertil Lintner, "Burma's Nuclear Temptation," *Yale Center for the Study of Globalization* (2008), <http://yaleglobal.yale.edu/display.article?id=11673> (accessed March 13, 2009); Geoffrey Gunn, "Southeast Asia's Looming Nuclear Power Industry," *The Asia-Pacific Journal: Japan Focus*, posted on February 11, 2008, http://www.japanfocus.org/Geoffrey_Gunn-Southeast_Asia_s_Looming_Nuclear_Power_Industry/ (accessed January 15, 2009).

¹⁹⁹ IAEA Nuclear Research Reactor Database, <http://www.iaea.org/worldatom/rddb/> (object name Nuclear Research Reactor in the World; accessed June 1, 2009).

nuclear technology ambition is that it is doing it for prestige and trying to keep up with its neighbors. Burma is receiving assistance with this 10 MW reactor from Russia's Rosatom. This international support is what makes Burma's nuclear endeavor possible. Russia is assisting Burma for two reasons. First, it is looking to increase its influence in the region and second, it is doing it for profit. It is even will to take payment from Burma in the form of primary goods such as agricultural products.²⁰⁰

Malaysia and the Philippines are two countries that are considering nuclear energy. Both countries have high electricity demand and both countries have alternatives to nuclear energy for electricity production. However, the mismatch in demand and available energy sources is a gap that is widening. The dominant factor with these two countries is political will. Malaysia has maintained an official position that it does not intend to pursue nuclear energy, but numerous indicators in Malaysia including statements by officials in energy-related offices point to a transition towards pursuing nuclear energy.²⁰¹ Political will is slowly building under the auspices of Nuclear Malaysia and the Malaysian government. Malaysia intends to slowly cultivate support for nuclear energy given that it has a relatively low level of urgency thanks to its natural gas reserves. In the Philippines, political will is working in the opposite direction. Due to a bad experience with the construction of the Bataan nuclear power plant (BNPP) during the Marcos administration, the public is strongly opposed to nuclear energy development. However, energy pressures have forced every Philippine administration to re-examine the issue since President Aquino established a policy against nuclear energy in the Philippines. Until domestic opinion on nuclear energy changes, the Philippines will not seriously pursue nuclear energy. A driver of this opinion change is the ever

²⁰⁰ Andrew Selth, "Burma and Nuclear Proliferation: Policies and Perceptions," *Griffith Asia Institute*, Regional Outlook Paper No. 12, 2007, 6–10, National Library of Australia <http://catalogue.nla.gov.au/Record/4189828?&#details> (accessed December 28, 2009).

²⁰¹ Nuclear Malaysia Database, http://www.nuclearmalaysia.gov.my/index.php?option=com_ (object name NUCLEAR POWER PLANNING & PROSPECTS IN MALAYSIA AND SOUTHEAST ASIA Power Point Presentation; accessed March 16 2008); Sarban Singh, "Malaysia to Use Nuclear Energy by 2023," *The Star Online*, September 20, 2008, <http://thestar.com.my/news/story.asp?file=/2008/9/20/nation/2080863&sec=nation> (accessed 16 March 2008)..

increasing cost of fossil fuel, both financially and environmentally. This driver is significant and may one day shift domestic opinion in the Philippines towards nuclear energy.

3. Countries That Are Pursuing Nuclear Energy

For the countries that are pursuing nuclear energy, the driving factors behind their decision to do so was electricity demand and lack of available alternatives to nuclear energy for large-scale electricity production. Indonesia and Thailand have high and increasing demand for electricity. Vietnam has a relatively low electricity demand in comparison to the other two countries but faces the prospect of a rapidly growing demand that will close the gap in a short period of time. All three have varying levels of available alternatives energy sources to nuclear power.²⁰² But the bottom line is that it will be extremely difficult to meet the expected increase in electricity demand after 2030 with these sources alone and the level of dependence on fossil fuels would be tremendous. Thus, all three countries are looking to nuclear energy on a trial basis to see if it is a viable alternative for large-scale electricity production and to reduce their dependence on increasingly expensive and depleting fossil fuels.²⁰³ The payoff for successfully expanding their electricity generation capacity to meet expected demands is sustained economic development. The combination of these two factors and the resulting benefit represents a legitimate need for nuclear energy.

The possibility of nuclear weapons proliferation as a result of this development is unlikely, but cannot be ignored. All countries in Southeast Asia have demonstrated a

²⁰² Asia-Pacific Economic Cooperation (APEC), *APEC Energy Demand and Supply Outlook 2006: Indonesia*, Asia Pacific Energy Research Center (Tokyo, 2006), 33–36, <http://www.ieej.or.jp/aperc/outlook2006.html> (accessed December 23, 2008); Asia-Pacific Economic Cooperation (APEC), *APEC Energy Demand and Supply Outlook 2006: Thailand*, Asia Pacific Energy Research Center (Tokyo, 2006), 95–97, <http://www.ieej.or.jp/aperc/outlook2006.html> (accessed December 23, 2008); Asia-Pacific Economic Cooperation (APEC), *APEC Energy Demand and Supply Outlook 2006: Vietnam*, Asia Pacific Energy Research Center (Tokyo, 2006), 105–110, <http://www.ieej.or.jp/aperc/outlook2006.html> (accessed December 23, 2008).

²⁰³ Geoffrey Gunn, "Southeast Asia's Looming Nuclear Power Industry," *The Asia-Pacific Journal: Japan Focus*, posted on February 11, 2008, http://www.japanfocus.org/Geoffrey_Gunn-Southeast_Asia_s_Looming_Nuclear_Power_Industry (accessed January 15, 2009); Andrew Symon, "Southeast Asia's Nuclear Power Thrust: Putting ASEAN's Effectiveness to the Test", *Contemporary Southeast Asia* 30, no. 1 (2008): 119–120, <http://muse.jhu.edu.libproxy.nps.edu> (accessed July 31, 2008).

trend towards the norm of non-proliferation through their actions. They are all members of numerous international institutions that support non-proliferation and have even established their own nuclear weapons free zone. The only scenario that would risk departure from this trend would require a significant shift in the security environment within the region. This shift is unlikely since all parties thus far have reaped benefits from the stable security environment present in the region today.²⁰⁴ This answers the question of why they elected to pursue nuclear energy.

As for answering the question of what determines how rapidly Indonesia, Thailand and Vietnam are pursuing nuclear energy, political will is the dominant factor. Vietnam has the most political will behind its program while Thailand has the least. Indonesia is in the middle. This lineup also corresponds to the lineup of how aggressively each country is pursuing nuclear energy. Although Vietnam is the late comer to the race, they have no expressed domestic opposition to nuclear energy development and the authoritarian government can direct significant efforts towards this endeavor.²⁰⁵ It is only limited by technical capacity in the form of available human resource constraints. This poses a risk to the timeline of Vietnam's first two reactors, but does not threaten its ultimate success.²⁰⁶

Although the Indonesian government has a long history of pursuing nuclear energy, it is doing so at a relatively cautious pace because of strong domestic opposition. The opposition argues that Indonesia's weak regulatory and administrative capabilities would fail to keep nuclear power safe, posing a great risk to the public. This safety concern stems from both the possibilities of reactor accidents from human errors or natural disasters, and the possibilities of reactor sabotage from terrorist or separatist groups. Indonesia is a known transit point for terrorists and its issues with violent

²⁰⁴ Michael S. Malley and Tanya Ogilvie-White, "The Development of Latent Nuclear Capabilities in Southeast Asia: is the Outcome 'All Too Predictable'?" *The Nonproliferation Review* 16, no. 3 (March 2009), 15–17, 23–27, <http://cns.miis.edu/npr/161toc.htm> (accessed March 15, 2009)

²⁰⁵ Gunn, "Southeast Asia's Looming Nuclear Power Industry."

²⁰⁶ Mark Hibbs, "More milestones set in 2009 for first two Vietnamese reactors," *Nucleonics Week* 49.44, October 30, 2008, 17, via Lexis-Nexis, <http://www.lexisnexis.com> (accessed December 5, 2008).

separatists are not completely resolved.²⁰⁷ In light of these challenges, Indonesia is progressing towards nuclear energy at a measured pace, using this time to strengthen its capabilities concerning safety and security. It is also using this time to win over the public by promoting the benefits of nuclear energy to its people.

Thailand is in political turmoil and no opposition to nuclear energy development has emerged from this political mess. The bureaucratic machine that is driving Thailand's nuclear power development will trudge along its set path until it runs into a key decision point that requires national leadership level review. Once it reaches this point, the progress towards nuclear energy development will grind to a halt, waiting for the political turmoil to end so this issue can be deliberated upon by the national leadership, who ever that may be once stability is restored. It is too politically risky for any decision to be made on this issue while political power in Thailand is not yet consolidated. Thailand also shares the safety and security concerns of Indonesia to some extent. Thailand is a known transit point for terrorists and the separatists in the southern provinces are still willing to resort to extremes to promote their objectives.²⁰⁸ The combination of these issues influence the political will towards nuclear energy in Thailand to a level of "progressive ambivalence." It will progress on its path to nuclear power until it reaches a decision point. Then it will be ambivalent until the politics in Bangkok settle down.

C. KEY FINDINGS AND IMPLICATIONS FOR THE UNITED STATES

In developing the answers to the thesis question, four key finding with implications for the United States were discovered. The first is that the motivation for nuclear energy in Southeast Asia is overwhelmingly for peaceful application. Each government pursuing nuclear energy has a legitimate need and lacks the security environment that would necessitate nuclear weapons. Furthermore, each Southeast Asian

²⁰⁷ Symon, "Southeast Asia's Nuclear Power Thrust: Putting ASEAN's Effectiveness to the Test," 125; Malley and Ogilvie-White 8–13; Andrew Symon, *Nuclear Power in Southeast Asia: Implications for Australia and Non-Proliferation* (Lowy Institute for International Policy [2008]): 5, 10–11.

²⁰⁸ Gunn; Malley and Ogilvie-White, 3, 16; Andrew Symon, *Nuclear Power in Southeast Asia: Implications for Australia and Non-Proliferation* (Lowy Institute for International Policy [2008]): 3.

country has demonstrated a commitment to the norm of non-proliferation through their membership in the NPT, the CTBT, and the SEANWFZ. They are also a party to the IAEA Nuclear Safeguard and Verification regime and the IAEA Additional Protocols. This is even true with Burma, whose intention behind nuclear technology pursuit is less than clear. This situation would indicate that nuclear energy development in Southeast Asia poses little threat to proliferation and thus less risk to U.S. interests in the region.

The second finding is that most governments lack strong regulatory and administrative capacities. Couple this with domestic security issues such as violent separatist groups and transnational terrorism and the task of ensuring adequate nuclear safety and security becomes a significant challenge. Although countries pursuing nuclear energy recognize these weaknesses and are making an effort to improve, their efforts alone may not be enough to mitigate the risk posed by these threat to a level acceptable to the United States without U.S. involvement. When the Global Threat Reduction Initiative (GTRI) coordinated the removal and return of weapons grade uranium from Da Lat Vietnam to Russia, it also made a commitment of \$80,000 for much needed security upgrades to the Da Lat research facility. What GTRI coordinators saw at Da Lat was typical of security standards in Southeast Asian countries and it is significantly below Western standards.²⁰⁹ This poses a risk to U.S. interest in security and stability in Southeast Asia. The U.S. policy towards nuclear energy development in Southeast Asia should be focused mainly on safety and security issues of this nature instead of proliferation. This is not to say that proliferation should drop off the radar completely, only that it is not the immediate threat.

The third finding is that nuclear power development in Southeast Asia is generally slow with the exception of Vietnam. This also reduces the risk to U.S. interest because it allows for some assessment and reaction time on the part of U.S. decision makers. Vietnam, as the lone standout should be more carefully watched because of the rate at which it is pursuing nuclear energy. The U.S. policy should promote maximum transparency with nuclear energy pursuers, especially Vietnam.

²⁰⁹ Ralph Vartabedian, "A Race with the Terrorist," *Los Angeles Times*, Edition A-1, September 27, 2007, via Lexis-Nexis, <http://www.lexisnexis.com> (accessed August 2, 2008).

The fourth finding is that most governments in Southeast Asia are extremely concerned with demonstrating compliance with international norms and regulations. This situation is conducive to U.S. engagement with countries pursuing nuclear energy to address safety and security issues, thus reduces the risk to U.S. interest in the region.

D. RECOMMENDED U.S. POSITION ON NUCLEAR ENERGY DEVELOPMENT IN SOUTHEAST ASIA

The United States stands to lose ground in the international order if it does not engage with countries in Southeast Asia on the issue of nuclear energy development. As the dominant pole in a world that is becoming more multipolar, the United States would be doing what is expected by engaging these fledgling nuclear energy developers. This engagement strategy must extend to every country interested in nuclear energy or nuclear technology, specifically Vietnam because of its rate of pursuit and Burma because of unclear motive behind its desire for nuclear technology. The engagement must be narrowly focused on the nuclear energy issues and support the audience country's efforts for peaceful application of nuclear energy and technology. It must not include political detractors such as human rights or democratic values; instead it should promote safety, security, transparency and nonproliferation. The singular purpose behind this engagement policy is the U.S. interest in regional stability. This policy will facilitate more access and avenues of communications with each country in the long run. It can become the U.S. "foot in the door" to increasingly reclusive Burma or another strand to strengthen the growing ties with Indonesia and Vietnam. If executed properly, this policy can be a road for the vehicles of national power to take into the heart of countries that would otherwise resist it.

1. The Benefits of an Engagement Policy

It is easy to see the benefits of supporting nuclear energy in Southeast Asian countries that are in good standing with the United States. But all countries serious about nuclear energy should be engaged. At present, these countries include Burma, Indonesia, Malaysia, Thailand, Vietnam and possibly the Philippines. All of these countries are already receptive to international support from various sources including the United

States in most cases. State to state engagement is only a natural evolution. Other Southeast Asian countries may follow. The benefits from engagement are strengthening ties of cooperation, providing an insider's level of transparency against proliferation and safety oversight, and allowing greater U.S. influence over the direction of development in those countries.

Extending engagement to countries not in good relations with the United States would extend these benefits to countries such as Burma. Through engagement, a level of transparency into the Burmese nuclear program can be ascertained. Burma was initially interested in assistance from the IAEA, signaling that it may be interested in assistance from other sources as well. The key again is to not attach any preconditions that will drive Burma away. Based upon Burma's response to U.S. offers of assistance during cyclone Nargis, Burma is wary of U.S. engagement. The reason for this may stem from the amount of U.S. criticism of its human rights record and its suppression of the democracy movement. Again, by not attaching engagement to these issues, U.S. engagement efforts stand a better chance of being accepted. This would reduce the risk of Burma's nuclear program and increase its level of transparency, an undeniable benefit to the United States.

2. Shaping the Engagement Policy

It is recognized that the engagement policy must be tailored to its audience country. However, to maintain unity of purpose there must be commonalities. The standard criteria conforming to international norms apply. It is not necessary to reinvent the wheel. These criteria were already well thought out for the U.S. Atoms for Peace Program. The cooperation must be for peaceful applications only. The level of transparency must be maximized to the greatest extent possible. Standards of safety and security must be reached and maintained throughout the program's life. These are only examples of some common sense criteria. The specifics would need further research and development. It is recognized that the Atoms for Peace criteria would be a good starting point and should be modified for applicability in today's environment. But the U.S. engagement program must do more than demand these criteria, it must help facilitate it.

Specific characteristics tailored to each individual audience country should also be weighed and analyzed. This can greatly affect the successful reception of U.S. engagement by catering to the societal actors and preferences within each country. Agriculture based economies with low levels of urbanization and/or relatively basic electric distribution networks may be more interested in the agricultural and medical application of nuclear technology. On the other hand, highly urbanized industrial countries with high electricity demands and a sufficiently robust electrical distribution system may be interested in nuclear energy. It is important to tailor the focus of the cooperation program towards what the audience country needs or thinks it needs. U.S. hubris has often placed the United States in difficult positions because U.S. policy dictates to the host nation what it thinks is good for that country rather than listening to what the host nation desires. This is not to say that U.S. policy should always conform to what the host nation desires, but rather that it should take those desires into account and address them seriously.

Cooperation with Southeast Asian countries developing nuclear energy or researching nuclear technology provides an avenue of engagement. Through this path, the United States can better position itself to monitor transparency and proliferation issues, address safety and security concerns, and eventually provide some influence in the energy policy of the audience country. The benefits to engagement outweigh the costs. For those that would accuse the United States of coddling dictators and ignoring the issues of human rights or democracy, it can be credibly argued that engagement on any level is better at opening the pathways for these issues to be addressed than isolation. If change is to occur, then influence must reach the authority within these countries. This nuclear energy renaissance can provide a second wave of increased U.S. influence into Southeast Asia through a policy of engagement and support.

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF REFERENCES

- Addison, Adrian. "Philippines revisits nuclear energy option at 'white elephant' plant." *Agence France-Presse*, January 8, 2009, <http://www.globalcollab.org/Nautilus/australia/reframing/aust-ind-nuclear/ind-np/asean-nuclear-power/philippines> (accessed January 16, 2009).
- Ardisasmita, M. S., Director of Center for Development of Information Technology and Computation, National Nuclear Energy Agency, Jakarta. "Preservation and Enhancement of Nuclear Knowledge Toward Indonesia's Plan to Operate First Nuclear Power Plant By 2016." Saclay, France: International Conference on Nuclear Knowledge Management Report no. IAEA-II-CN-123, September 2004.
- Asia-Pacific Economic Cooperation. *APEC Energy Demand and Supply Outlook 2006*. Tokyo: Asia Pacific Energy Research Center, 2006. <http://www.iecej.or.jp/aperc/outlook2006.html> (accessed December 23, 2008).
- Asia-Pacific Economic Cooperation. *APEC Energy Overview 2007*. Tokyo: Asia Pacific Energy Research Center, 2007. <http://www.iecej.or.jp/aperc/2007pdf/Overview2007.pdf> (accessed February 4, 2009).
- Association of Southeast Asian Nations. *Treaty on the Southeast Asia Nuclear Weapon-Free Zone Bangkok, Thailand*, 1995. <http://www.aseansec.org/2082.htm> (accessed April 2, 2009).
- Badan Tenaga Nuklir Nasional (BATAN), Indonesia Nuclear Agency Database. <http://www.batan.go.id/en2008/profil.php> (object name BATAN Profile: BATAN History; accessed May 11, 2009).
- Brunei Energy Association. <http://www.bena.org.bn/> (object name Profile; accessed February 9, 2009).
- Burma River Network database. <http://www.burmariversnetwork.org/> (object name Upper and Lower Paunglaung Dams; accessed March 10, 2009).
- Burma River Network database. <http://www.burmariversnetwork.org/> (object name *Country Report on Progress of Power Development Plans and Transmission Interconnection Projects: Myanmar* power point presentation, November 21, 2008; accessed March 13, 2009).
- Buszynski, Leszek and Iskandar Sazlan. "Maritime Claims and Energy Cooperation in the South China Sea." *Contemporary Southeast Asia* 29, no. 1 (2007). Project Muse <http://muse.jhu.edu/journals/> (accessed April 3, 2008).

- Central Intelligence Agency. "Geography, People, Government and Economy Information." *The World Factbook*, 2009. <https://www.cia.gov/library/publications/the-world-factbook/geos/id.html> (accessed 26 January 2009).
- Comprehensive Nuclear-Test Ban Treaty Organization. Member States, Status of Signature and Ratification database. http://www.ctbto.org/member-states/?no_cache=1 (accessed April 1, 2009).
- Electricity Generating Authority of Thailand (EGAT). "Thailand Power Development Plan 2007-2021." *System Plan Division* Report no. 912000-5104, January 2008.
- ElBaradei, Mohamed, IAEA Director General. "Nuclear Power: Looking to the Future." *Statement of the Director General at Nobel Laureate Public Lecture*, Kuala Lumpur July 2007. <http://www.iaea.org/NewsCenter/Statements/2007/ebasp2007n011.html> (accessed April 3, 2009).
- Gourevitch, Peter A. *Politics in Hard Times: Comparative Responses to International Economic Crisis*. Ithica: Cornell University Press, 1986.
- Gunn, Geoffrey. "Southeast Asia's Looming Nuclear Power Industry," *The Asia-Pacific Journal: Japan Focus* (2008), http://www.japanfocus.org/Geoffrey_Gunn-Southeast_Asia_s_Looming_Nuclear_Power_Industry/ (accessed January 15, 2009).
- Haûi, An Nhö. "Technical Labor: A Decisive Factor for the Economic Growth." University of Economics, Ho Chi Minh City, 2000, www.ueh.edu.vn/tcptkt/english/2000/thang9/techni.htm (accessed May 8, 2009).
- Hibbs, Mark. "More milestones set in 2009 for first two Vietnamese reactors." *Nucleonics Week* 49.44, October 30, 2008. Lexis-Nexis, <http://www.lexisnexis.com> (accessed December 5, 2008).
- Hickey, Neil. "A Nuclear Indonesia?" *Energy Tribune*, May 19 2008, <http://www.energytribune.com/articles.cfm?aid=898> (accessed December 5, 2008).
- "Hundreds Protest in Myanmar Over Fuel Price Hike." *Forbes*, August 19, 2007. <http://www.forbes.com/afxnewslimited/feeds/afx/2007/08/19/afx4033455.html> (accessed December 29, 2008).
- International Atomic Energy Agency database. http://www-TC_project.iaea.org/TC_projectweb/default.asp (object name Department of Technical Cooperation; accessed July 25, 2008).

- International Atomic Energy Agency. “Nuclear Power As An Engine for Development: IAEA Chief Addresses Nuclear Power’s Outlook in Talks in Thailand and Malaysia.” International Atomic Energy Agency News Center. http://www.iaea.org/NewsCenter/News/2007/dg_thaimalay.html (accessed December 12, 2008).
- International Atomic Energy Agency. Nuclear Research Reactor Database. <http://www.iaea.org/worldatom/rrdb/> (object name Nuclear Research Reactor in the World; accessed June 1, 2009).
- International Atomic Energy Agency. *Nuclear Safeguards and Verification*. http://www.iaea.org/OurWork/SV/Safeguards/sg_protocol.html (accessed April 3, 2009).
- International Atomic Energy Agency. “Third IAEA Report on Kashiwazaki-Kariwa Nuclear Power Plant Published.” *Kashiwazaki-Kariwa Nuclear Plant Indicated Safe Performance of the Plant Staff Report*, January 2009. <http://www.iaea.org/NewsCenter/News/2009/kashiwazaki290109.html> (accessed May 7, 2009).
- Jo, Dong-Joon and Erik Gartzke. “Determinants of Nuclear Weapons Proliferation.” *Journal of Conflict Resolution* 51, no. 1 (February 2007): 169-173. <http://proquest.umi.com.libproxy.nps.edu/login/ipauto> (accessed November 17, 2008).
- Kimsong, Kay. “Cambodia Sets Sights on Nuclear Power.” *The Phnom Penh Post*, September 29, 2008. <http://www.phnompenhpost.com/index.php/2008092921879/Business/Cambodia-sets-sights-on-nuclear-power.html> (accessed October 20, 2008).
- Lee Kwan Yew. Transcript of Minister Mentor Lee Kuan Yew’s Dialogue with Singapore Energy Conference on November 4, 2008, Raffles City Convention Centre. <http://www.news.gov.sg/> (accessed 19 November 2008).
- Lim, Chandara and Suon Ponnarith. “Energy Resources in Cambodia.” General Directorate of Energy Hydro Electricity Department. Hangzhou Regional Center (Asai-Pacific) for Small Hydro Power (SHP), http://www.hrcshp.org/en/world/db/Energy_Resources_in_Cambodia.pdf (accessed December 23, 2008).
- Lintner, Bertil. “Burma’s Nuclear Temptation.” *Yale Center for the Study of Globalization* (December 3, 2008). <http://yaleglobal.yale.edu/display.article?id=11673> (accessed March 13, 2009).
- Malaysia Ministry of Science, Technology and Innovation (MOSTI). *Malaysian Nuclear Agency 2006 Annual Report*, May 2007. http://www.nuclearmalaysia.gov.my/index.php?option=com_content&task=blogcategory&id=111&Itemid=105 (accessed January 16, 2009).

- Malley, Michael S. "Prospects for Nuclear Proliferation in Southeast Asia, 2006-2016," *NonProliferation Review* 13, no. 3 (2006): 605-615.
- Malley, Michael S. and Tonya Ogilvie-White. "The Development of Latent Nuclear Capabilities in Southeast Asia: Is the Outcome "All Too Predictable"?" *Nonproliferation Review* 16, no. 3 (2009): 1-30. <http://cns.miis.edu/npr/161toc.htm>
- Medium-Term Philippine Development Plan 2004-2010*. Chapter 11: Power Sector Reform, Philippines National Economic and Development Authority, 2004, 130. <http://www.neda.gov.ph/ads/mtpdp/MTPDP2004-2010/PDF/MTPDP2004-2010.html> (accessed April 29, 2009)
- Mohamad, Daud. "Statement by Dr. Daud Mohamad, Director General, Malaysian Nuclear Agency, Head of Delegation of Malaysia to the 52nd Regular Session of the General Conference of the International Atomic Energy Agency (IAEA)." Vienna: October 2008.
- Montlake, Simon. "Why the Thai-Cambodian Temple Dispute Lingers." *The Christian Science Monitor*, July 22, 2008. <http://www.csmonitor.com/2008/0722/p06s02-wosc.html> (accessed May 11, 2009).
- Munthit, Ker. "Cambodia Eyes Nuclear Plant for Electricity." *Associated Press*, September 26, 2008. <http://www.ap.org> (accessed October 20, 2008).
- Mydans, Seth. "Myanmar monk protest contained by Junta forces." *The New York Times*, September 28, 2007. <http://www.nytimes.com/2007/09/28/world/asia/28cnd-myanmar.html> (accessed December 29, 2008).
- Mydans, Seth. "Tens of thousands join Myanmar protest." *International Herald Tribune*, September 24, 2007. <http://www.iht.com/articles/2007/09/24/news/myanmar.php> (accessed December 29, 2008).
- "The nation must ensure the safety of the people from ecological disaster." *Friends of the Earth Indonesia (WALHI) online*. http://www.eng.walhi.or.id/kampanye/psda/070702_ipc_cu (accessed December 5, 2008).
- Nuclear Malaysia Database, <http://www.nuclearmalaysia.gov.my/index.php?option=com> (object name Nuclear Power Planning & Prospects in Malaysia and Southeast Asia PowerPoint; accessed March 16 2008).
- Owen, Norman G. "Malaysia Since 1957," Chap 29 in *The Emergence of Modern Southeast Asia*. Honolulu, HI: University of Hawai'i Press, 2005.
- Perin, Constance. *Shouldering Risk: The Culture of Control in the Nuclear Power Industry*. Princeton: Princeton University Press, 2005.

- Palatino, Mong. "The Philippines' Failed Nuclear Experiment." *United Press International (UPI) Asia*, July 3, 2008, http://www.upiasia.com/Economics/2008/07/02/the_philippines_failed_nuclear_experiment/6312/ (accessed March 12, 2009).
- Percaya, Desra, Delegates of the Republic of Indonesia at the General Debate of the First Committee of the 63rd Session of the United Nations General Assembly, October 7, 2008, (acquired from <http://www.reachingcriticalwill.org/> accessed January 15, 2009).
- Philippines Nuclear Research Institute (PNRI) Database. <http://www.pnri.dost.gov.ph/> (accessed April 1, 2009).
- Pholsena, Sommano and Daovong Phonekeo. *Loa hydropower potential and policy in the GMS context*. United Nations Symposium on Hydropower and Sustainable Development Beijing, China, October 27, 2004
- Quilop, Raymund Jose. "Using Nuclear Energy: A Philippine Experience." Council for Security Cooperation in the Asia Pacific (CSCAP), Nuclear Transparency in the Asia Pacific. http://www.cscap.nutrans.org/Nuc_Trans/links/frames/top-participants.htm (accessed January 16, 2009).
- Reuters. "Four Firms Eyes Thai Nuclear Power Plant Project." *Thomson Reuters*, January 11, 2008. <http://www.reuters.com/article/rbssConsumerGoodsAndRetailNews/idUSBKK31050420080111> (accessed May 7, 2009).
- Salam, Nurkhayrul. "BEnA to Host Forum on Nuclear Energy." *The Brunei Times*, September 11, 2008. Brunei Times, http://www.bt.com.bn/en/news/2007/09/11/bena_to_host_forum_on_nuclear_energy (accessed October 20, 2008).
- Selth, Andrew. "Burma and Nuclear Proliferation: Policies and Perceptions." *Griffith Asia Institute*, Regional Outlook Paper No. 12, 2007, 6-10. National Library of Australia <http://catalogue.nla.gov.au/Record/4189828?&#details> (accessed December 28, 2009).
- Sheffield, John, A. Gibson, P. Vandenplas, M. Keilhacker, J. F. Davies, K. Lackner, G. H. Wolf, R. D. Gill, P. Thomas, I. Cook, H. Bruhns, M. Watkins, R. S. Pease. "World Population and Energy Demand Growth: The Potential Role of Fusion Energy in an Efficient World [and Discussion]." *Philosophical Transactions: Mathematical, Physical and Engineering Sciences* 357, no. 1752, The Approach to Ignited Plasma, The Royal Society (March 15, 1999), 377-395. JSTOR via Dudley Knox Library, <http://www.jstor.org/stable/55119> (accessed July 30, 2008).

- Singh, Sarban. "Malaysia to Use Nuclear Energy by 2023." *The Star Online*, September 20, 2008. <http://thestar.com.my/news/story.asp?file=/2008/9/20/nation/2080863&sec=nation> (accessed March 16, 2008).
- Smith, Rand W. "International Economy and State Strategies: Recent Work in Comparative Political Economy." *Comparative Politics*, 25, no. 3 (1993), 351–372. JSTOR, <http://www.jstor.org.libproxy.nps.edu>.
- Somvichith, Sanhya. *Hydropower in Lao PDR and Power Development Plan*, PowerPoint presentation at Executive Summary on Electricite Du Laos (EDL) and Laos Hydropower Development November 21, 2008, Department of Electricity, Ministry of Mines, <http://www.edl-laos.com/> (accessed December 30, 2008).
- Sundaravej, Samak. *Inaugural Address by His Excellency Mr. Samak Sundaravej, Prime Minister of the Kingdom of Thailand*, April 28, 2008.
- Stubbs, Richard. "Liberalization, Economic Crisis and Regionalism." Chap 7 in *Rethinking Asia's Economic Miracle*. New York: Palgrave Macmillan, 2005.
- Sukin, Kamol. "Thailand Seeks Cooperation From ASEAN Plus Three on Proposed Nuclear Power Plant." *The Nation (Internet Version-WWW)* in English, June 17, 2008. Lexis-Nexis, <http://www.nexis.com> (accessed July 31, 2008).
- Symon, Andrew. *Nuclear Power in Southeast Asia: Implications for Australia and Non-Proliferation*, Sydney: Lowy Institute for International Policy, 2008.
- Symon, Andrew. "Southeast Asia's Nuclear Power Thrust: Putting ASEAN's Effectiveness to the Test?" *Contemporary Southeast Asia*, 30, no. 1 (2008): 118 - 139. Project Muse via Dudley Knox Library, <http://muse.jhu.edu.libproxy.nps.edu> (accessed July 20, 2008).
- Thailand Ministry of Science and Technology (MOST) Database. http://www.most.go.th/engCMS/index.php?option=com_content&task=view&id=60&Itemid=81 (object name Office of Atoms for Peace; accessed May 11, 2009)
- Thailand Office of Atoms for Peace. <http://www.oeap.go.th/english> (accessed December 12, 2008).
- "Toshiba Completes Westinghouse Acquisition." Westinghouse press release, October 2004. http://www.prnewswire.com/cgi-bin/micro_stories.pl?ACCT=no&TICK=WE&STORY=/www/story/10-17-2006/0004453746&EDATE (accesses April 22, 2009).
- Transparency International. 2008 Corruption Perception Index. http://www.transparency.org/policy_research/surveys_indices/cpi/2008 (accessed April 29, 2009).

- United Nations. "Draft: Cambodia Energy Sector Strategy." United Nations Department of Economic and Social Affairs, Division for Sustainable Development. <http://www.un.org/esa/agenda21/natinfo/countr/cambodia/energy.pdf> (access December 23, 2008).
- United Nations. "Status of Multilateral Arms Regulation and Disarmament Agreements." New York: United Nations Office of Disarmament Affairs (UNODA). <http://disarmament.un.org/TreatyStatus.nsf> (accessed April 3, 2009)
- United Nations and the World Bank. *Burma Issues and Options in the Energy Sector*, United Nations Development Programme and the World Bank Energy Sector Assessment Program Report No. 5416-BA, 1985.
- United States, Department of Energy. "Country Analysis Brief." *Energy Information Administration of the United States Government*, 2009. <http://www.eia.doe.gov/emeu/cabs/> (accessed December 22, 2008).
- United States, Department of State Databases. <http://www.state.gov/r/pa/ei/bgn/35910.htm> (object name Background Note: Burma; accessed March 13, 2009).
- Weatherbee, Donald E. "Conflict and Conflict Resolution in Southeast Asia," and "Terrorism and Transnational Crime in Southeast Asia." Chap 5 and Chap 6 in *International Relations in Southeast Asia*. Oxford: Rowman and Littlefield, 2005.
- "Vietnam announces plan to build two nuclear power plants in central province." *BBC Monitoring Asia Pacific*, November 3, 2008. <http://www.nexis.com> (accessed December 5, 2008).
- Vietnam Atomic Energy Commission Database. <http://www.vaec.gov.vn/> (accessed December 5, 2008).
- Vartabedian, Ralph. "A Race with the Terrorist." *Los Angeles Times*, Edition A-1, September 27, 2007. Los Angeles Times, via Lexis-Nexis, <http://www.nexis.com> (accessed July 20, 2008).
- Vongsiry, Sithanh and Khamphanh Vanlasy. *2002 International Training Course on Chinese SHP*. Lao Peoples Democratic Republic Ministry of Industry and Handicraft Electricite Du Laos Country Paper (Vientiane 2002). Hangzhou Regional Center (Asia-Pacific) for Small Hydro Power (SHP) <http://www.hrcshp.org/en/world/db/Laos.pdf> (accessed December 23, 2008).
- Wipatayotin, Apinya. "Thai Source: ASEAN Members Pledge To Share Information on Nuclear Power," *Bangkok Post (Internet Version-WWW)* in English, September 21, 2007. Lexis-Nexis via Dudley Knox Library, <http://www.nexis.com> (accessed July 31, 2008).

The World Bank, *Project Paper on a Proposed Grant in the Amount of SDR 1.64 Million (US \$2.5 Million Equivalent) to the Democratic Republic of Timor-Leste for Energy Services Delivery Project*, The World Bank International Development Association Report No: 39717-TP, June 7, 2007, 1, http://www-wds.worldbank.org/external/default/main?pagePK=64193027&piPK=64187937&theSitePK=523679&menuPK=64187510&searchMenuPK=64187283&siteName=WDS&entityID=000020439_20070614093828 (accessed December 23, 2008).

Yab Dato' Seri Abdullah Haji Ahmad Badawi, Prime Minister of Malaysia. "Building a Civilisation to Elevate the Nation's Dignity." Motion on Ninth Malaysia Plan 2006–2010, *the Star Online*, 31 March 2006, <http://thestar.com.my/news/story.asp?file=/2006/3/31/nation/20060331170915&sec=nation> (accessed 12 March 2009).

Zaw, Aung. "Burma Plays Nuclear Card." *The Irrawaddy*, 15, no. 7, June 2007. www.irrawaddy.org (accessed December 30, 2008).

Zhu Li. "Political Turmoil Grooms Thailand's Outlook." *Xinhua Chinese News Agency*, April 15, 2009. http://news.xinhuanet.com/english/2009-04/15/content_11188902.htm (accessed May 8, 2009).

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center
Ft. Belvoir, Virginia
2. Dudley Knox Library
Naval Postgraduate School
Monterey, California